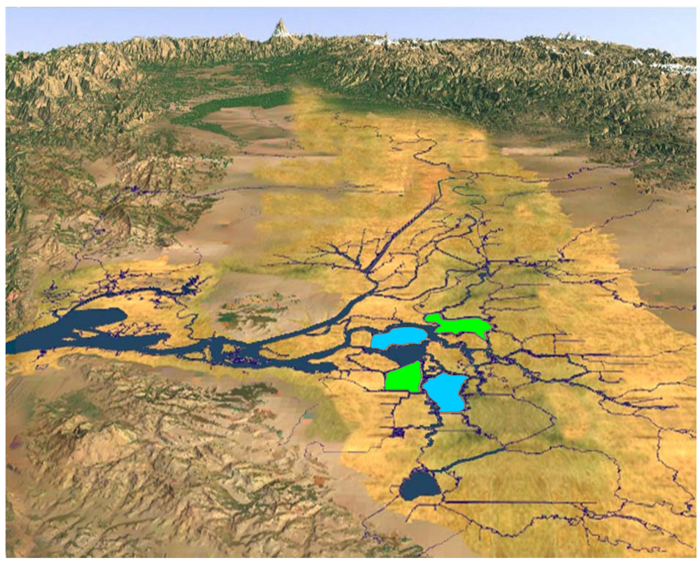
INTEGRATED STORAGE INVESTIGATIONS

IN-DELTA STORAGE PROGRAM
STATE FEASIBILITY STUDY
DRAFT REPORT ON ECONOMIC ANALYSES



CALIFORNIA
BAY-DELTA
AUTHORITY

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

Division of Planning and Local Assistance
Department of Water Resources
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ORGANIZATION

FOREWORD

We acknowledge the technical assistance provided by Reclamation in carrying out the role of federal lead agency for the CALFED Integrated Storage Investigations. Reclamation has not yet completed a full review of the State Feasibility Study reports. Reclamation will continue to provide technical assistance through the review of the State Feasibility Study reports and DWR will work with Reclamation to incorporate comments and recommendations in the final reports.

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Chapter 1: INTRODUCTION

1.1 General

Two types of economic analysis were done for this study. First, benefit and cost information was developed to evaluate the economic justification for the proposed project alternatives and the results of this analysis are given in Chapter 2. Second, a project area economic impact analysis was made to disclose the potential for both positive and negative impacts to the economy of the local area. While the former analysis is traditionally done using only direct costs and benefits, the latter analysis considers indirect and induced local economic effects—the "ripple" effects. The results of the project area economic impact analysis on the local economy are given in Chapter 3.

An assessment of potential benefits is an important part of the feasibility study process. Typically, project decision-makers compare estimated benefits to estimated costs to determine if a proposed project warrants further consideration and possible implementation. If estimated benefits compare favorably with estimated costs, then environmental documents (including a project description and operations plan) and necessary permits are finalized, and financial feasibility is assessed.

Economic analyses of the example Sample Scenarios (Chapter 2) were based on preliminary assumptions of the cost and availability of the regional water use efficiency options (e.g., conservation, wastewater recycling, groundwater reclamation etc.). DWR estimates the equivalent annual cost for the In-Delta Storage Project at approximately $60 million. Based on a conservative preliminary assessment of the example Sample Scenarios the average annual water supply benefits produced by the In-Delta Storage Project would be valued at approximately $23 to 26 million. An additional $2 million in annual benefits would be associated with the recreation, flood damage reduction and avoided levee maintenance provided by the project. For example, case sensitivity analyses for the Sample Scenario 2 South Coast benefits (see Appendix A) indicate that there is a significant variation in South Coast benefits, and results of the economic analyses are very sensitive to the assumptions about the cost and availability of regional water use efficiency options. In general, for example, if the assumptions are unreasonably optimistic about cost and/or availability of the regional options, the value of the In-Delta Storage Project will be understated. Another source of sensitivity is the assumption of how much value water users place on water system reliability. In general, if this value is unreasonably low, the value of the In-Delta Storage Project will again be understated. Some of the other important assumptions which can significantly affect the value of the In-Delta Storage Project are identified in Appendix A.

DWR needs additional assistance from economic experts and potential beneficiaries in reviewing the assumptions and procedures used in this analysis before finalizing this assessment. In addition, many of the benefits such as operational flexibility, water quality improvements, wildlife and habitat improvements and seismic stability, have not yet been quantified. Before total project benefits and cost can be compared, value must be assigned to these benefits. All potential project participants, including the State must use judgment to estimate the value of the benefits the In-Delta Storage Project might provide and determine if those benefits justify the project costs. The Department will work with the Bay-Delta Public Advisory Committee and the California Bay-Delta Authority to gather input from interested parties before completing this benefits assessment.

Any future steps on the In-Delta Storage Investigation should include refinement of the operational and economic analyses. This refinement should consider uncertainty in future operations at the State Water Project's Banks Pumping Plant, the OCAP, and other important CALFED Program actions that are being studied simultaneously. Also, DWR should work with stakeholders to improve the assumptions in the economic models and quantify all of the benefits discussed in this report for a better numerical comparison of benefits and costs.

Chapter 2: ECONOMIC BENEFIT AND COST ANALYSIS

2.1 General

Economic Analysis is based on evaluation of Equivalent Annual Cost of project implementation including costs of project development, construction, mitigation and operation and maintenance, and the benefits as a result of increased project exports, operational flexibility, CVPIA(b)(2), Environmental Water Account and potential for water transfers.

Unit water supply cost simply compares the equivalent annual project cost to the average annual water supply benefit on a dollars per acre-foot basis. This assessment should not be construed as the “cost per acre-foot of water supply.” Instead, this economic evaluation should be considered one of many feasibility indicators that must be taken into consideration for project screening.

To estimate the urban and agricultural water supply economic benefits two models were used for the Sample Scenarios. An urban economic evaluation was performed using the Least-Cost Planning Simulation Model (LCPSIM) while the agricultural evaluation was preformed using the Central Valley Planning Model (CVPM). The economic assumptions, evaluation methodologies, and study results are discussed below.

2.2 Project Costs

Project costs were developed for In-Delta Storage Project. These costs include regulatory costs, capital costs and O&M costs.

2.2.1 Regulatory Costs

Regulatory costs reflect documentation, permitting and initial monitoring and mitigation expenses. Estimated initial environmental mitigation and monitoring costs are given in Table 1.

Table 1: Regulatory Costs
(2003 Dollars)

Alternative	Mitigation, Monitoring & Regulatory Costs
In-Delta Storage Project	$34,450,000

2.2.2 Forgone Investment Value

The Foregone Investment Value was calculated based on the construction estimate, engineering and regulatory costs. The Forgone Investment Value sometimes referred to as Interest During Construction, is typically considered in estimating the total capital cost of a proposed project. Throughout the construction period, funds are withdrawn from the economy to support the construction process. These allocated funds are therefore not available during the construction period for alternative investment opportunities that would provide net economic returns. A discount rate of 6 percent was assumed for this adjustment.

A construction period of five years was assumed for the project. For Cost Allocation purposes, cost of proposed storage facilities construction is assumed as follows.

Year 1: Land Acquisition Cost plus 15 percent Conveyance Facilities and Levee Improvements Costs
Year 2: 20 percent Conveyance Facilities and Levee Improvement Costs
Year 3: 25 percent Conveyance Facilities and Levee Improvement Costs
Year 4: 20 percent Conveyance Facilities and Levee Improvement Costs
Year 5: 20 percent Conveyance Facilities and Levee Improvement Costs

Forgone Investment Values are shown below in Table 2.

Table 2: Forgone Investment Value Adjustment
(Millions of 2003 Dollars)

Alternative	Project Total Construction Costs *	Years to Construct	Adjustment (Year 4)	Adjustment (Year 3)	Adjustment (Year 2)	Adjustment (Year 1)	Adjustment (Year 0)	Total Adjustment
In-Delta Storage Project	522	5	36.3	19.9	16.1	6.3	-	78.6

* Does not include mobilization cost

2.2.3 Project Capital Cost

Project Capital Cost includes the following.

- Total Construction Cost including engineering design, legal and construction
- Forgone Investment Value

Project Capital Cost including the Construction Cost, Regulatory Cost and Foregone Investment Values are given in Table 4.

2.2.4 Annual Cost

The annual cost is the sum of the three elements: (1) the capital recovery cost, (2) property tax loss in-lieu property tax payments for loss of agriculture, and (3) the recurring annual costs. The first element includes the amortized total capital cost. The second element includes the loss of revenues due to loss of agricultural lands and in-lieu payment. The third element includes operation and maintenance costs as well as energy costs incurred for the project operations.

- Capital Recovery - Annualized capital costs were developed for each of the proposed projects. This is based on the total capital costs amortized over a fifty-year period with an assumed discount rate of 6 percent.
- In-lieu property tax payments
- Recurring Annual Operation and Maintenance Costs: These costs include the following items.
  - Levee maintenance
  - Intake and Outlet structures maintenance including pumping stations, gate units, siphons and fish screens for both, reservoir and habitat islands.
  - Pumping Energy costs
  - Seepage control systems maintenance and monitoring
  - Water quality monitoring, and
  - Environmental monitoring including wildlife and habitat monitoring.

Annual O&M Costs are shown in Table 3 and Total Capital and O&M costs are summarized in Table 4.

Table 3: Annual Operation and Maintenance Cost
(2003 Dollars)

Item	Amount
1. Embankment Maintenance	$ 837,000
2. Integrated Facilities and Fish Screen Maintenance	$ 400,000
3. Pump Operations	$ 983,000
4. Seepage Control System	$ 610,000
5. Habitat Islands, Fishery Monitoring and O&M	$ 1,700,000
6. Invasive Weed Control on Reservoir Islands	$ 722,000
7. Recreation	$ 265,000
8. Cultural Resources Mitigation	$ 10,000
9. Property Taxes	$ 346,000
Total Operation and Maintenance Costs	**$ 5,873,000**

Table 4: Total Capital and Equivalent Annual Cost Development
(Millions of 2003 Dollars)

Alternative	Total Project Cost	Forgone Investment Adjustment	TOTAL CAPITAL COST	Annual Capital Cost	Annual O&M Cost	EQUIVALENT ANNUAL COST
	A	B	C	D	E	F
			A+B			D+E
In-Delta Storage Project	774.4	78.6	853.0	54.1	5.9	60.0

2.3 Assessment of Project Benefits

2.3.1 General

The stakeholders and potential recipients of the water supply from this project should conduct their own analyses to estimate the value of the benefits. Because this is only one possible allocation, no specific monetary value has been displayed in this analysis which would allocate benefits to specific beneficiaries. DWR needs additional assistance from economic experts and potential beneficiaries in reviewing the assumptions and procedures used in this analysis before finalizing this assessment. Project benefits included in the economic evaluation are quantified as follows:

- Additional SWP/CVP System Exports for urban and agricultural use including Joint Point of Diversion
- Contribution to meet CVPIA South of Delta Refuges
- Environmental Water Account
- Ecosystem Restoration Program
- Groundwater Recharge
- Flood Risk Reduction
- Levee Maintenance Cost Reduction
- Recreation

Project benefits described in qualitative terms are:

- wildlife habitat improvements;
- interim banking for water transfers storage;
- seismic stability;
- value of water quality improvements; and
- operational flexibility

2.3.2 Urban and Agricultural Water Supply Benefits

To estimate the urban and agricultural water supply economic benefits two models were used. An urban economic evaluation was performed using the DWR's Least-Cost

Planning Simulation Model (LCPSIM) while the agricultural benefits were evaluated with the Central Valley Planning Model (CVPM).

For the purpose of economic assessment of the In-Delta Storage Program, DWR established a methodology using available economic models to quantify potential benefits. Project deliveries input to the economic models was created by the CALSIM model which simulates project operations using a 73-year historic hydrology as described in Chapter 3, Operation Studies.

This initial simulation provides an estimate of direct increased water deliveries to urban and agricultural water users, as well as an assessment of additional water supply benefits that might be allocated to increase stream flows for the benefit of fisheries and water quality, provide supplies to the Environmental Water Account, provide additional supplies for direct delivery or transfer to agricultural or urban water users. The tables in the following sections show estimated benefits for the Sample Scenarios. Other variations in project operations are possible and may be identified in subsequent analysis or negotiations. The estimated benefits of the project will be re-assessed when alternative operations are identified. A sensitivity analysis for the example Sample Scenario 2 for the South Coast urban model assumptions, as presented in Appendix A, was done to determine the variations in potential benefits as a result of changes in assumptions for the regional management options.

Economic analysis information presented in this report is based on evaluation of equivalent annual cost of project implementation including costs of project development, construction, mitigation and operation and maintenance, and benefits of the project. The engineering and environmental studies evaluated the capital cost of building the project and mitigation required for project impacts. The operation and water quality studies provided information on potential benefits of the In-Delta Storage Project. Two types of economic analyses were done for this study. First, benefit and cost information from operations, water quality, engineering and environmental evaluations became input for the economic justification for the proposed project. Second, a project area economic impact analysis was done to disclose the potential for both positive and negative impacts to the economy of the local area.

2.3.2.1 Urban Benefits

The following assumptions and analysis criteria were important to the urban benefits analysis:

- Benefits in relation to base deliveries include 2020 impacts on shortage related costs and losses and on the economic justification for adding additional local reliability from the available water use efficiency options (e.g., water recycling). The benefits of any alternative are determined by the change in total avoided costs and losses: shortage-related and related to the use of local water use efficiency options.
- Within the South Coast and the San Francisco Bay Regions, the necessary capacity and policies needed to move available supplies among urban users to

mitigate any localized shortage-related economic impacts caused by disparities in supply availability are assumed to be in place in 2020.

- The conservation options used in LCPSIM are beyond those expected to be implemented by 2020 under the urban Best Management Practices MOU.
- Regionally, the San Francisco Bay Region is expected to be at a relatively high level of reliability in 2020 after the assumed adoption of economically justified local water conservation and supply augmentation measures in the context of the assumed availability of local carryover storage. Consequently, SWP deliveries available under contract and interruptible deliveries that were not of net economic value to the region (hereafter referred to as unallocated deliveries) were assumed to be available to augment SWP South Coast Region urban deliveries.
- Additional SWP deliveries made to the San Joaquin Valley based on demand identified with the Kern Water Bank are assumed to be available to recharge available groundwater storage capacity used by the Metropolitan Water District of Southern California under arrangements made with San Joaquin Valley water districts. The total capacity available to MWDSC in the San Joaquin Valley is assumed to have been increased by about 0.5 MAF by 2020 and operated for about the same unit cost to MWDSC as the existing programs in the San Joaquin Valley.
- Because of the level of local reliability that will be justified in 2020 within the region and the assumed availability of local carryover storage, the unallocated San Francisco Bay Region deliveries, SWP supplies available under contract, available through storage operations in the San Joaquin Valley, and interruptible supplies not of net economic value to the South Coast Region were assumed to augment SWP agricultural deliveries. The incremental unallocated deliveries produced by the project were assumed to augment CVP agricultural deliveries.
- Also, SWP deliveries driven by the Kern Water Bank delivery targets in excess of MWDSC San Joaquin Valley banking operation use are assumed to be available for groundwater management in the San Joaquin Valley.
- Supplies available to, but not delivered for SWP urban use generated by in-Delta storage can be retained for CVPIA refuges water or can be credited to CVP for agricultural uses. For this study, the deliveries were credited to CVP agricultural users. This logic is meant to model one potential outcome of market based future water allocation negotiations between urban and agricultural users (in this case, an unconstrained “free-market” bookend.)
- Although the implementation of urban water conservation measures reduce the frequency and magnitude of shortages, demand hardening effects are assumed to cause an increase in economic losses when water shortages do occur. Because of the increased efficiency with which water is being used and the already implemented conservation measures (assumed to be less costly than the remaining conservation options) no longer available for shortage management, the value of new supply is therefore increased during shortage events.
- Reliability benefits for the Central Coast Region, an area not covered by the LCPSIM model, was interpolated from the results produced by LCPSIM for the South Coast Region.

- Benefits of in-Delta storage to urban users of SWP supplies in the San Joaquin Valley are based on the cost of existing local groundwater operations.
- Benefits of in-Delta storage to urban users of SWP supplies in the South Lahontan Region are based on project cost studies for applications submitted for Proposition 13 grants for groundwater storage projects.

a. Urban Reliability Benefits Analysis with LCPSIM

The Least-Cost Planning Simulation Model has been developed to assess the economic benefits and costs of increasing water service reliability to urban areas by evaluating the economic consequences of the yearly changes in demands and availability of water supplies. LCPSIM measures water service reliability benefits by estimating the ability of shortage management (contingency) measures to mitigate regional costs and losses associated with a shortage. Assumptions about the effectiveness of regional long-term and shortage contingency options that can be employed to enhance reliability are incorporated into LCPSIM along with estimates of their costs. One of the primary objectives of LCPSIM is to develop an "economically efficient" regional water management plan.

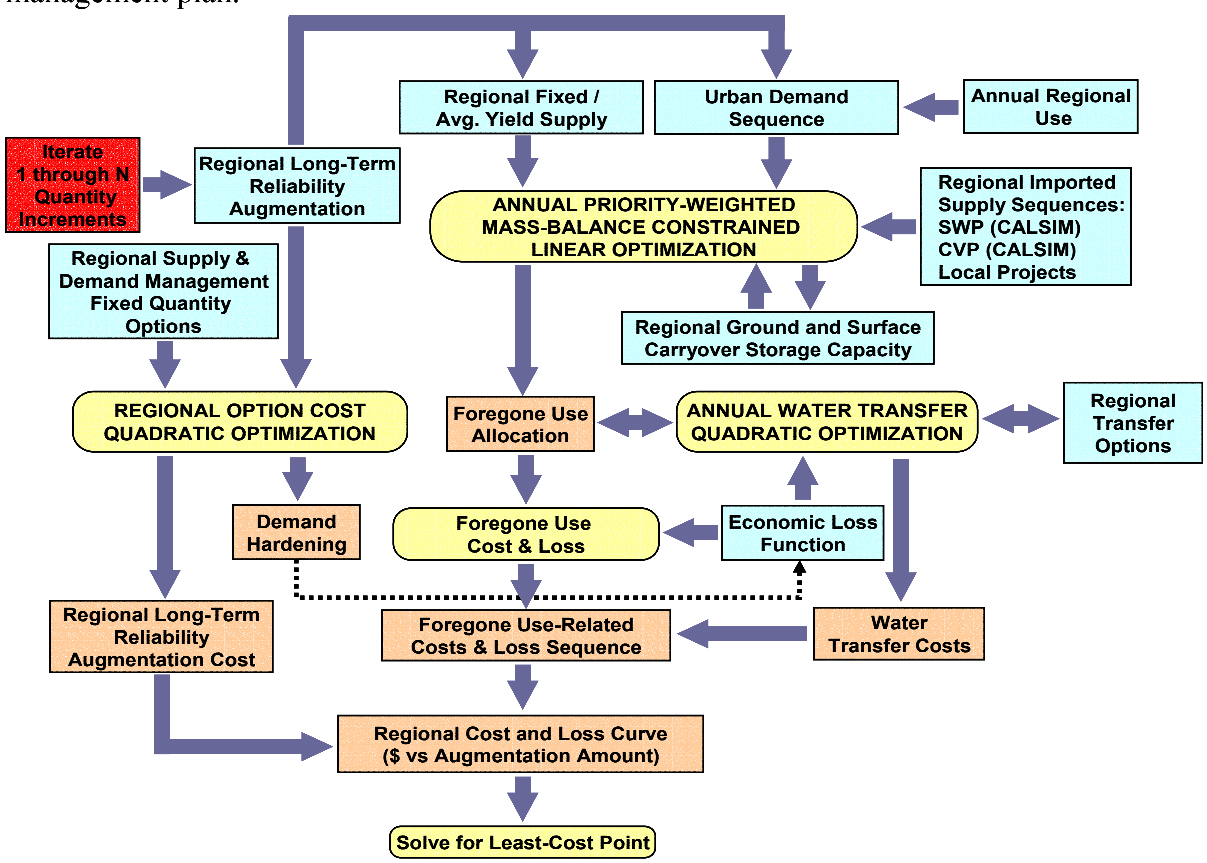

Figure 1: LCPSIM Logic

In LCPSIM, a priority-based objective, mass balance-constrained linear programming solution is used to simulate regional water management operations on a yearly time-step, including the operation of surface and groundwater carryover storage capacity assumed to be available to the region. Economic losses due to shortage events are based on a residential water user loss function. The cost of adding regional long-term water management measures is determined using a quadratic-programming algorithm. Quadratic programming is also used to simulate water market purchases during shortage events, solving for the least-cost combination of shortage-related economic losses and the cost of transferred water. Demand hardening—the increase in the size of the economic losses associated with specific shortage events—is related to the level of use of regional long-term conservation measures. The least-cost combination of economic risk, regional long-term water management facilities and programs, and contingency water transfers is identified within the model for each alternative water management plan being evaluated. Figure 1 shows the major model logic flows. Figure 2 provides the details of the inputs.

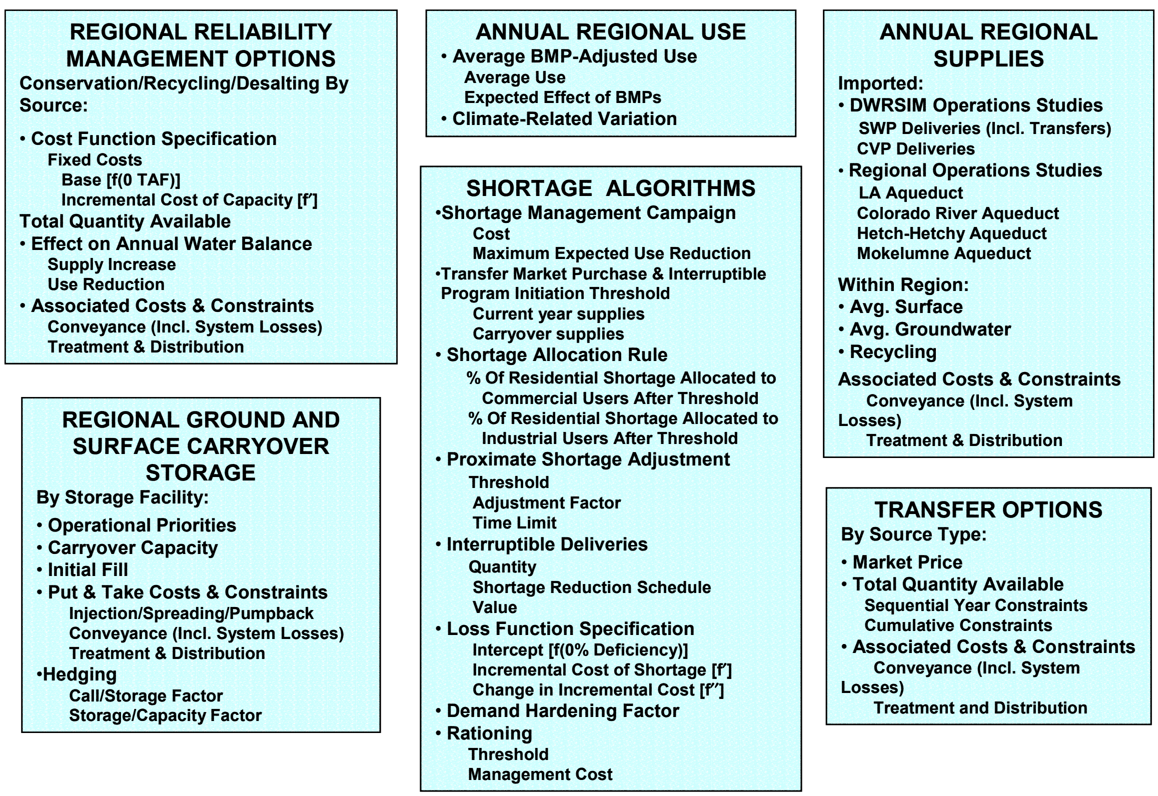

Figure 2: LCPSIM Data and Parameters

LCPSIM takes a comprehensive view of water supply reliability, incorporating key information on the frequency, size, and impacts of shortages. Regional water managers and users must respond primarily to actual year-to-year fluctuations in demand level and water supply availability rather than to average levels of demand and supply. As shortages increase in magnitude and regularity, shortage management becomes increasingly important. LCPSIM evaluates the economic justification of the level of reliability enhancement provided by any combination of long-term water management options in the context of regionally available contingency options. Regional water management options are divided into three categories: (1) shortage contingency demand management and supply augmentation; (2) long-term demand management and supply enhancement; and (3) economic risk management. The latter accepts a known degree of economic risk from shortages in order to avoid the use of other water management options that are perceived to be even more costly.

Depicted in Figure 3 is an example of an analysis of the benefits for the South Coast Region. The lower curve represents the cumulative capital and OM&R cost of adding additional local long-term reliability. The upper two sets of curves represent the shortage-related losses (includes shortage-relates costs) and total costs (the sum of losses and the cost of adding local long-term reliability. The first set represents the without project condition (the curves which start at the same point at left in the uppermost position.) The second set (starting somewhat lower at left) represents the with project condition. As can be seen, while the losses drop as local reliability increases, the total cost increases after an initial drop for both sets of curves.

The lowest points on the total cost curves are identified by the diamond for the without project condition and the square for the with project condition. These points represent the economically efficient (least-cost) management plans for each condition. The benefit of the project is the amount by which the least-cost plan for the “with project” condition is lower (less expected total costs and losses) than the least-cost plan for the “without project” condition.

The following LCPSIM assumptions should be noted:

- Economic benefits are computed at specifically identified demand levels (e.g., Year 2020 level) only. This conforms the model to CALSIM hydrologic output which is generated for specific study year levels, which are tied to fixed levels of demand and upstream depletions, rather than over a period of time. Because the economic life of the alternatives to be evaluated can be up to fifty years, benefit estimation will be biased if only a single study year level is used. Currently, because the most-distant CALSIM study year for this program is 2020, the results can be biased due to expected increases in urban demand beyond the year 2020. Conversely, if studies at less distant times (e.g., Year 2005) are not made, a project may be brought on line before it is economically justified to do so.

- Regional water supply sources that are not modeled on a year-to-year basis in the LCPSIM are assumed to be continually at their average year values. This simplifying assumption can bias the results by not capturing the large costs and losses which can arise when shortages occur on these regional supplies and the explicitly modeled imported supply systems concurrently. This bias is most likely to be present when the regional area has limited carryover storage capacity compared to the size of current-year use. Similarly, the benefits of the coincidence of "surpluses" on both systems is not correctly taken into account, although this bias is reduced in areas with limited carryover storage capacity.

Both situations will tend to show less benefits from increased reliability than would otherwise be the case.

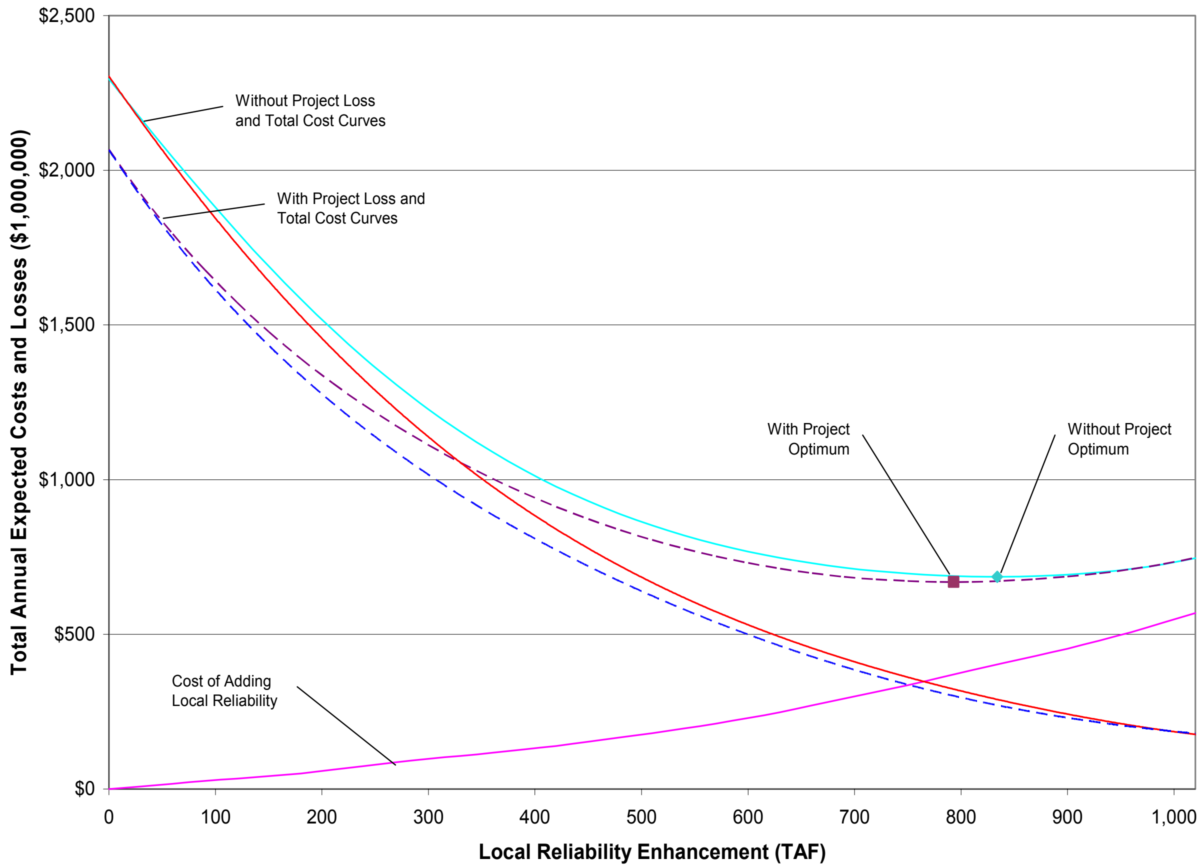

Figure 3: LCPSIM Optimization Example

The determination of reliability benefits is done in LCPSIM on the basis of a risk-neutral view of risk management. Risk-averse management (risk minimization) by regional agencies--which has been the predominant mode--would result in the justification of more costly water management options than under the risk-neutral assumption.

LCPSIM assumes that the regions being evaluated have the facilities and institutional agreements in place to move water as needed to minimize the impact of shortages. Because this is more or less unlikely to be the situation, the model may undervalue the benefits of additional CVP/SWP supplies for this reason. This is problematic, however, because of the interaction between local reliability, the assumed availability of local carryover storage, the economically justified level of adoption of local constant yield reliability management options, and the timing of the availability of the CVP/SWP supplies. Assuming a reduced ability of the region to mitigate shortages with intra-regional water transfers may result in assigning a higher value to the CVP/SWP supplies taken, for example, but the amount of those supplies actually useable because of their timing may be reduced (i.e., the CVP/SWP source is relegated to more of a peaking supply.)

The urban demand numbers used in LCPSIM are not changed in response to the higher urban user water costs which can be anticipated as regional agencies add to their supply reliability by developing regional supplies or paying for Statewide supply options. The demand numbers used are taken from Bulletin 160-98 and reflect the extensive adoption of Urban Best Management Practices. The adoption of these BMP's significantly reduces flexibility of users to respond to price (see the discussion of "demand hardening" above) and it can be reasonably assumed that at least part of the reason for their adoption is pricing incentives. For these reasons, putting a price elasticity of demand factor on top of these assumptions would constitute double counting and would be likely to seriously overstate the effect of water price increases. To the extent that this double counting does not occur, the model would overestimate the value of adding reliability enhancement options.

The LCPSIM model was run for both the San Francisco Bay Region and the South Coast Region. Demands were based on the 2020-level values developed for DWR Bulletin 160-98 and include the forecasted levels of adoption of best management practices (BMPs) for urban conservation. The residential user loss function was assumed to be the same for both regions. Shown in Table 5 is the willingness to pay to avoid one-time shortages of specific sizes by residential customers with specified annual water use rates (use per year per household). Users in the commercial and industrial water use sectors– where, above a threshold shortage size, marginal losses were assumed to be higher–were allocated proportionately less of the overall shortage during shortage events by the LCPSIM logic in order to allow the application of this loss function to the entire shortage.

Table 5: LCPSIM Loss Function Values
(1999 Dollars)

Deficiency	Willingness to Pay/Shortage Event ($/Acre-Foot Use/Year/Household)		
	0.75	0.65	0.55
0%	$0	$0	$0
5%	$49	$43	$36
10%	$145	$126	$106
15%	$278	$241	$204
20%	$439	$380	$322
25%	$618	$535	$453
30%	$804	$697	$590
35%	$990	$858	$726

Carryover storage capacity allows a current year supply, which is in excess of current year use to be held over to meet use during years with supply deficiencies. Carryover storage capacity can exist in surface reservoirs or in groundwater basins. The operation of groundwater capacity is generally less effective for shortage management because annual refill (put) and extraction (take) rates can be relatively limited compared to reservoir storage capacity. Shown in Table 6 are the carryover storage assumptions used for the South Coast Region.

Table 6: South Coast Region Carryover Storage Capacities
(1999 Dollars)

Operation	Capacity(TAF)	Init. Fill	Rech. Eff.	Put Limit(TAF)	Put Cost	Take Limit(TAF)	Take Cost	Class	Type	Put Prty	Take Prty	Description
1	210	50%	90%	55	$90	70	$85	6	1	3.0	5.0	GW Banking Operations
2	220	100%	100%	220	$0	220	$0	1	1	1.0	7.0	Reserve Reservoir Operations
3	860	50%	100%	200	$0	200	$0	2	6	5.0	1.0	Local Reservoir Operations
4	580	50%	100%	30	$0	225	$75	3	2	6.0	3.0	In-Lieu GW Operations
5	580	50%	90%	200	$20	0	$75	3	1	7.0	4.0	GW Spreading Operations
6	860	50%	100%	660	$0	660	$0	2	1	2.0	2.0	Regional Reservoir Operations
7	800	50%	90%	150	$18	150	$60	4	4	3.5	5.5	Colo R. Aq. GW Banking Operations
8	1,430	50%	90%	310	$130	360	$85	5	3	4.0	6.0	Calif. Aq. GW Banking Operations

The capacities listed are not additive for the South Coast Region because Operations 3 and 6 share the same surface reservoir storage capacity. Similarly, Operations 4 and 5 share the same groundwater storage capacity. The operations are separately identified in the model to allow for differences in refill and use operations in terms of priority, cost, or annual put and take capacities. Operation 2, reserve reservoir storage, is also identified separately because of differences in priority of refill and use compared to other surface reservoir storage.

The Department recently received a list of water management facilities and water transfer program assumptions used for the Metropolitan Water District of Southern California's Integrated Resources Planning model. This information was used to develop assumptions for groundwater storage operations along the California Aqueduct in the San Joaquin Valley and along the Colorado River Aqueduct near Desert Center in Riverside County.

Table 7: San Francisco Bay Area Carryover Storage Capacities
(1999 Dollars)

Operation	Capacity(TAF)	Init. Fill	Rech. Eff.	Put Limit(TAF)	Put Cost	Take Limit(TAF)	Take Cost	Shared Cap.	Type	Put Prty	Take Prty	Description
1	100	50%	100%	100	$0	100	$0	2	1	1	1	Local Reservoir Storage
2	100	50%	95%	100	$15	20	$16	3	1	2	2	Local GW Spreading
3	443	50%	95%	70	$90	70	$85	5	3	3	3	External Banking

Shown in Table 7 are the carryover storage capacity assumptions for the San Francisco Bay Region. This capacity includes recent agreements for banking water in the San Joaquin Valley patterned after the agreement made for the South Coast Region (Option 7, above).

Shortage contingency water transfers were assumed to be available for both regions. The maximum annual level of contingency transfers assumed to be available from the San Joaquin Valley was 200 taf for the South Coast Region and 100 taf for the San Francisco Bay Region, the amounts assumed to be available through the DWR Dry Year Water Purchase Program and other transfer options. Transfer options were assumed to cost about $175/af, excluding conveyance (conveyance costs are specified elsewhere as input to LCPSIM).

In addition to these transfers, any Colorado River Aqueduct capacity remaining after accounting for the base allocation of the Colorado River supply, Quantification Settlement Agreement Transfers, and transfers from Colorado River Aqueduct banking operations, is assumed to be able to be filled with transferred supplies from water market purchases (up to 372 TAF). These latter transfers are assumed to be called upon if the available regional supplies are below 95 percent of current consumptive demand. (Up to a 5 percent shortage was assumed to be relatively easily managed with a contingency conservation program which the model assumes would be triggered by a shortage of this size.)

Each transfer was constrained not to occur over 25 percent of the time unless the quantity transferred was less than the maximum annual amount available (i.e., 250 percent of the maximum annual amount in any ten year period). If less than the maximum available was transferred, the frequency could be proportionately higher. The quantity transferred during any two consecutive years also could exceed the maximum annual amount available. These constraints apply independently to each transfer source identified. In addition, transfers could only be used when the available regional supplies are below 90 percent of current consumptive demand.

The Central Valley agricultural water transfers resulting from the LCPSIM runs were used to reduce the surface supplies available to SWP and CVP contractors in the CVPM agricultural production model for those years that the transfers occurred. A 50 percent allocation of the transferred amount to each project was assumed. Income from these transfers is included in the agricultural benefits analysis in the form of foregone agricultural production value. Transfer costs which exceed this value are assumed to be transactions costs paid by urban users.

Long-term demand management options that are adopted by water users can have a demand hardening effect. Although they can increase reliability by reducing the size, frequency and duration of shortage events, they can make these events relatively more costly when they do occur. This occurs because these options tend to reduce or eliminate the least valuable water uses and/or the least efficient water use methods. This means that things are already “closer to the bone” for users and they are more vulnerable when shortages happen (i.e., the marginal value of supply is increased). For LCPSIM runs, the hardening factor was assumed to be 50 percent (e.g., if long-term conservation decreases use by 10 percent in the absence of a shortage, then the economic impact of a shortage of a specified size is computed as if the shortage was actually 5 percent greater.)

Table 8 is the option input table used for the South Coast Region. Information from DWR Bulletin 160-98 was used to develop the data in the table. The conservation options shown in Table 8 represent actions beyond those assumed to have been implemented to achieve the level of conservation already incorporated in the study demands due to the adoption of best management practices.

Table 8: South Coast Region Options
(1999 Dollars)

Source	Amount Avail (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	67	$750	$0.00	2	Conservation I (New Dev. - Outdoor)
2	110	$400	$0.00	2	Conservation II (Indoor - 60GPCD)
3	110	$800	$0.00	2	Conservation II (Indoor - 55GPCD)
4	30	$500	$0.00	2	Conservation III (3% Non-Resid. Use)
5	18	$1,167	$0.00	2	Conservation III (5% Non-Resid. Use)
6	84	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	93	$395	$3.20	1	Groundwater Recovery I
8	2	$890	$0.00	1	Groundwater Recovery II
9	4	$179	$0.00	1	Water Recycling I
10	236	$236	$0.70	1	Water Recycling II
11	226	$433	$2.40	1	Water Recycling III
12	13	$1,180	$0.00	1	Water Recycling IV
13	5	$2,147	$165.00	1	Water Recycling V
14	5	$920	$0.00	1	Ocean Water Desalting I (base)
15	100	$1,030	$0.00	1	Ocean Water Desalting II (base)
16	100	$1,700	$0.00	1	Ocean Water Desalting III (base)

One difference in the assumptions on available options for the South Coast Region was that the Bulletin assumed that diversions from the Colorado River Aqueduct were held at 550 taf in the base case. Transfer, conservation, and land fallowing options for the Colorado River Region to augment this supply were developed for the Bulletin. For the purposes of the in-Delta study, the quantity of water assumed to be available on a constant basis through the Colorado River Aqueduct was assumed to be 828 TAF, with additional quantities available up to the capacity of the Aqueduct (1.2 MAF) on a contingency basis (see transfers discussion above). The contingency supply was assumed to cost $175 per acre-foot at the time of use. These assumptions were made to approximate the effect of the recent Quantification Settlement Agreement.

Table 9 is the option input table used for the San Francisco Bay Region which was also developed from information used in Bulletin 160-98.

Table 9: San Francisco Bay Region Options
(1999 Dollars)

Source	Amount Available (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Cost (Peak Use) ($/AF)	Source (Type)	Description (AlphaNumeric)
1	2	$750	$0.00	$0	2	Conservation I (New Dev. - Outdoor)
2	38	$400	$0.00	$0	2	Conservation II (Indoor - 60GPCD)
3	38	$800	$0.00	$0	2	Conservation II (Indoor - 55GPCD)
4	11	$500	$0.00	$0	2	Conservation III (3% Non-Resid. Use)
5	7	$1,167	$0.00	$0	2	Conservation III (5% Non-Resid. Use)
6	13	$300	$0.00	$0	3	Conservation IV (System Loss @ 5%)
7	9	$510	$0.00	$0	1	Groundwater Recovery I
9	20	$95	$0.00	$0	1	Water Recycling I
10	4	$243	$0.00	$0	1	Water Recycling II
11	24	$563	$28.50	$0	1	Water Recycling III
12	1	$2,381	$0.00	$0	1	Water Recycling IV

Price elasticity of water demand was considered in two ways, the economic optimization logic used in LCPSIM depends on comparing the marginal cost of additional regional conservation to the marginal cost of additional regional supply and the marginal expected cost of shortages. Demand is therefore a function of the overall regional economic efficiency of water management in light of the CALFED alternative being evaluated.

The effect of the with project case was evaluated with LCPSIM by running the model with the CVP/SWP deliveries expected under the base case to obtain the least-cost combination of shortage-related costs and losses (including shortage management costs) and the investment and operations costs of long-term water management options (i.e., the least-cost solution). The model was then run with the change in deliveries expected with the project in place. The least-cost solutions for each Program Alternative were then compared to the original results.

Because the increased CVP/SWP deliveries, particularly during dry and critical years, LCPSIM achieves a least-cost solution for both regions with lower total costs (i.e., a superior least-cost solution) with the project in place. This can be achieved either by a reduction in expected shortage-related costs and losses or by avoiding the costs associated with long-term water management options no longer needed to achieve the least-cost solution, or both. It should be noted that, compared to the base case, some superior least-cost solutions can be achieved with higher shortage-related costs and losses or higher costs associated with the implementation and use of long-term water management options since the net effect is a lower total cost.

The SWP and CVP water deliveries used by LCPSIM are generated by the CALSIM project operations model. The model is driven by target delivery quantities, which it tries to meet based on available inflows and storage's on the SWP and CVP systems for each year of the 2020 level hydrology used. Additionally, SWP deliveries are made to the San Joaquin Valley based on target deliveries identified with the Kern Water Bank. These deliveries are assumed to be available to recharge available groundwater storage capacity used by the Metropolitan Water District of Southern California under arrangements made with San Joaquin Valley water districts. The total capacity available to MWDSC in the San Joaquin Valley is assumed to have been increased by about 0.5 MAF by 2020 and operated for the same unit cost to MWDSC as specified in LCPSIM for their existing programs in the San Joaquin Valley. This capacity and cost assumption was incorporated in the base case as well as the alternative scenarios.

Because these targets are set independently of the LCPSIM model, the economically efficient (i.e., least-cost) water management plan for the South Coast or San Francisco Bay Region in the context of the assumed availability of local carryover storage produced a level of reliance on local supply and conservation options which resulted in the target deliveries having been set too high for the wetter years.

In-lieu of iterating the CALSIM model with revised target deliveries, the assumption was made that a reallocation of the "excess" supply to the San Francisco Bay Region would be made to the South Coast Region in the years which it was available. Subsequently, any remaining "excess" supply was reallocated to CVP agricultural contractors. This latter quantity was used to augment annual deliveries to San Joaquin CVP agricultural contractors in the CVPM agricultural production model. In this manner, the LCPSIM results were linked to the CVPM results through the urban to agricultural reallocation of deliveries during the wetter years and the agricultural to urban transfers during dry and critical years as discussed earlier. SWP deliveries driven by the Kern Water Bank delivery targets in excess of MWDSC San Joaquin Valley banking operation use is assumed to be available for improving groundwater management in the San Joaquin Valley.

The costs and loss values shown in the previous tables were based on 1999 level dollars. The Table 10 and Table 11 provide a summary of the results indexed to year 2003 level dollars for the three operational scenarios. In the case of the South Coast Region, the available supply includes that available to recharge the groundwater storage capacity available to MWDSC in the San Joaquin Valley as discussed above. This latter supply is assumed to be available for delivery for use in the South Coast Region only after being stored prior to that use.

Table 10: Summary of LCPSIM Results for the San Francisco Bay Region
(2003 Dollars)

Regional Economic Benefits	Study Alternative		
	urban_deliv_study2	urban_deliv_study3	urban_deliv_study4
Avg Incremental Available Urban Supply (TAF)	4.4	4.4	3.1
Avg Incremental Unallocated Urban Supply (TAF)	3.4	3.3	2.1
Net Avg Incremental Delivered Urban Supply (TAF)	1.1	1.0	1.0
Average Incremental Urban Dry Period Available Supply (TAF)	3.4	3.3	2.4
Average Incremental Urban Unallocated Dry Period Supply (TAF)	1.5	1.3	0.8
Average Incremental Urban Delivered Dry Period Supply (TAF)	2.0	2.0	1.6
Avoided Costs/Losses ($1,000)	$224	$220	$123

Regional Water Management -- Least-Cost Planning Criterion				
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**		
	$5,790	-$167	-$163	-$64
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**		
Total Quantity Transferred (TAF)	52	2.0	2.0	2.0
Total Cost ($1,000)	$9,783	$376	$376	$376
Annual Average Cost ($1,000)	$125	$5	$5	$5
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**		
Conservation (TAF)	34	-1	-1	-1
Groundwater Recovery (TAF)	0	0	0	0
Recycling (TAF)	20	0	0	0
Seawater Desalting (TAF)	0	0	0	0
Total Option Use (TAF)	54	-1	-1	-1
Total Annual Option Cost ($1,000)	$14,258	-$410	-$410	-$410
Expected Incremental Operations Costs ($1,000)	-$12,174	$348	$347	$345
Total Expected Costs and Losses ($1,000)	$8,009	-$224	-$220	-$123

Table 11: Summary of LCPSIM Results for the South Coast Region
(2003 Dollars)

Regional Economic Benefits	Study Alternative		
	urban_deliv_study2	urban_deliv_study3	urban_deliv_study4
Avg Incremental Available Urban Supply (TAF)	82.9	61.5	54.8
Avg Incremental Unallocated Urban Supply (TAF)	76.5	44.3	49.6
Net Avg Incremental Delivered Urban Supply (TAF)	6.4	17.3	5.2
Average Incremental Urban Dry Period Available Supply (TAF)	35.6	28.7	19.8
Average Incremental Urban Unallocated Dry Period Supply (TAF)	10.8	6.4	6.5
Average Incremental Urban Delivered Dry Period Supply (TAF)	24.9	22.3	13.3
Avoided Costs/Losses ($1,000)	$14,723	$13,621	$8,887

Regional Water Management -- Least-Cost Planning Criterion				
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**		
	$190,234	-$25,854	-$12,220	-$14,651
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**		
Total Quantity Transferred (TAF)	2,900	-44.0	58.0	61.0
Total Cost ($1,000)	$545,563	-$8,278	$10,911	$11,476
Annual Average Cost ($1,000)	$6,952	-$113	$149	$157
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**		
Conservation (TAF)	300	13	-7	6
Groundwater Recovery (TAF)	89	0	0	0
Recycling (TAF)	343	0	0	0
Seawater Desalting (TAF)	0	0	0	0
Total Option Use (TAF)	732	13	-7	6
Total Annual Option Cost ($1,000)	$346,124	$10,470	-$5,578	$4,815
Expected Incremental Operations Costs ($1,000)	$45,961	$775	$4,027	$792
Total Expected Costs and Losses ($1,000)	$589,792	-$14,723	-$13,621	-$8,887

b. Central Coast Region Urban Supply Benefits

Benefits to the central cost region are estimated based on the LCPSIM results developed for the South Coast Region. It was also assumed that the South Coast Region ratio of available supply to delivered supply would also be applicable to the Central Coast Region. For this purpose, the ratio is calculated from a South Coast Region study done without assuming supplies made available to the South Coast Region from an enhanced San Joaquin Valley groundwater banking program. Any undelivered Central Coast Region supply which would then be available for an alternative use would represent an added value for the in-Delta program. Unlike the South Coast Region undelivered supply, which is explicitly modeled, no specific analysis is made to determine its potential value.

c. San Joaquin Valley Urban Supply Benefits

The unit cost of existing local groundwater conjunctive use operations is estimated to be about $140 per acre-foot (including capital recovery and operations) and the operations cost of delivery of the SWP supply was estimated to be about $30 per acre-foot. Both figures include the estimated cost delivered at the treatment plant. This cost difference, about $110 per acre-foot, represents a floor on the future value of the SWP supply to the local urban water users, given the assumption that, without the additional increment of SWP delivery, the local conjunctive use facilities would have to be expanded. To the extent that the existing facilities were the least costly to develop, this value is likely to be conservative. On this basis, the 2.9 TAF made available is estimated to be worth about $319,000 annually.

d. M&I Benefits in Other Areas

Deliveries to SWP M&I users served by the following contractors: AVEK WA, Palmdale WD, Littlerock Creek ID, Mojave WA, Coachella Valley WD, Desert WA, Crestline-Lake Arrowhead WA. Benefits to urban users in these areas is based on project cost studies for applications submitted for Proposition 13 grants for groundwater storage projects: about $200 per acre foot.

e. Summary of Urban Water Supply Benefits

The urban water supply deliveries are shown in Table 12:

Table 12: Summary of Urban Water Supply Deliveries

Benefit Category	Scenario 2 (Study 2)		Scenario 3 (Study 3)		Scenario 4 (Study 4)	
	Annual Water Supply Improvement (TAF)		Annual Water Supply Improvement (TAF)		Annual Water Supply Improvement (TAF)	
	Dry Period	Long-term Average	Dry Period	Long-term Average	Dry Period	Long-term Average
SF Bay Region	2.0	1.1	2.0	1.0	1.6	1.0
South Coast Region	24.9	6.4	22.3	17.3	13.3	5.2
Central Coast Region	0.9	1.3	0.8	1.3	0.6	0.9
San Joaquin Valley	1.2	2.6	1.1	2.5	0.6	1.8
Other Urban	3.6	5.4	3.4	5.3	2.4	3.9
Total	32.6	16.8	29.6	27.4	18.5	12.8

The urban economic benefits described above are summarized in Table 13.

Table 13: Summary of Urban Water Supply Economic Benefits
(2003 Dollars)

Benefit Category	($1,000)		
	Scenario 2 (Study 2)	Scenario 3 (Study 3)	Scenario 4 (Study 4)
SF Bay Region[1]	$224	$220	$123
South Coast Region[1]	$14,723	$13,621	$8,887
Central Coast Region	$428	$422	$317
San Joaquin Valley	$286	$275	$198
Other Urban	$1,080	$1,060	$780
Total	$16,741	$15,598	$10,305

[1]Includes water market transfers from San Joaquin Valley agricultural use to the SF Bay and South Coast Region urban use

2.3.2.2 Agricultural Benefits

The following assumptions and analysis criteria were important to the agricultural benefits analysis:

- Both short-run and long run responses to changes in water resource conditions will be evaluated. The purpose of the long-run analysis is to estimate average economic conditions after farmers have made long-term adjustments to changes in supply availability and economic conditions. The purpose of the short-run analysis is to estimate acreage, crop mix, and water use during above and below average hydrologic events, given farmers' best possible responses to the temporary situation.
- The potential sources for agricultural supply in each region are identified as CVP water service contract supply, CVP water rights and exchange supply, State Water Project (SWP) supply, local surface supply, and groundwater.
- In the base case (i.e., no action alternative), unallocated contract SWP urban deliveries are allocated to San Joaquin Valley SWP and CVP agricultural contractors in proportion to their deliveries under their respective contracts.
- The additional unallocated contract SWP urban deliveries produced by the project are used to augment CVP agricultural deliveries.
- To reflect the reasonable (and conservative) assumption that planted acreage would not be based on Article 21 deliveries because of planting decision constraints, planted acreages are held to the amounts which resulted from the evaluation of contract deliveries. In this manner, only reductions in local agricultural ground water pumping costs due to the in-lieu surface supply would be the benefit of these deliveries.

a. Agricultural Reliability Benefits Analysis with CVPM

Increased imported surface water supply reliability for agriculture generates increased benefits from the ability of farmers to increase their planted acreage and/or reduce more costly groundwater pumping. The timing of the supply as well as its quantity is important. In dry and critical years, when local surface supplies become less available, the increased availability of imported supplies can allow crops to be planted that would otherwise not have been planted, mitigating farm income impacts. In wetter years, the increased availability of imported supplies can reduce groundwater pumping costs (and help groundwater basins recover through in-lieu recharge.)

(The text immediately below was adapted from the US Bureau of Reclamation (Reclamation) Central Valley Improvement Act Draft PEIS, September 1997. Figure 4 and Table 14 and Table 15 are also from that document.)

The Central Valley Production Model (CVPM) is a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. Farmers sell and buy in competitive markets, and no one farmer can affect or control the price of any commodity. To obtain a market solution, the model's objective function maximizes the sum of producers' surplus (net income) and consumers' surplus (net value of the agricultural products to consumers) subject to the following relationships and restrictions:

(1) Linear, increasing marginal cost functions estimated using the technique of positive mathematical programming. These functions incorporate acreage response elasticities that relate changes in crop acreage to changes in expected returns and other information.
(2) Commodity demand functions that relate market price to the total quantity produced.
(3) Irrigation technology tradeoff functions that describe the tradeoff between applied water and irrigation technology.
(4) A variety of constraints involving land and water availability and other legal, physical, and economic limitations.

The model selects those crops, water supplies, and irrigation technology that maximize profit subject to these equations and constraints. Profit is revenue minus costs. From (1) above, cost per acre increases as production increases. Revenue is irrigated acreage, times crop yield per acre, times crop price. From (2) above, crop price and revenue per acre decline as production increases. Relation (3) affects costs and water use through the selection of the least-cost irrigation technology. Relation (4) ensures that the model incorporates real-world hydrologic, economic, technical, and institutional constraints. The model includes 22 crop production regions in the Central Valley and 26 categories of crops. A map of the regions appears as Figure 4. Descriptions of each of the regions and crop types are provided in Tables 14 and 15, respectively.

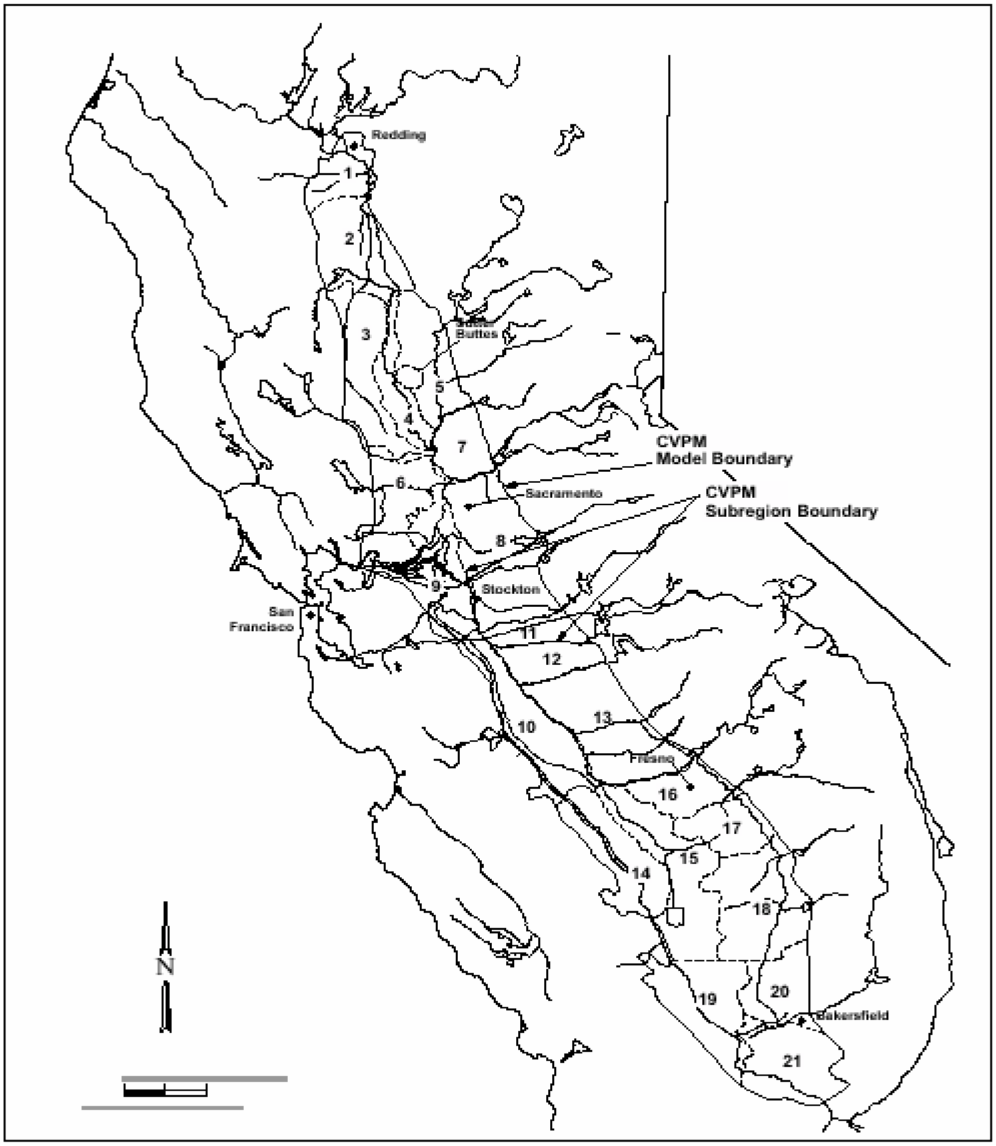

Figure 4: Area Covered by CVPM

Table 14: Water Districts Covered by CVPM

CVPM REGIONS AND DESCRIPTIONS

CVPM Region	Description of Major Water Users
1	CVP Users: Anderson Cottonwood, Clear Creek, Bella Vista, Sacramento River miscellaneous users.
2	CVP Users: Corning Canal, Kirkwood, Tehama, Sacramento River miscellaneous users.
3	CVP Users: Glenn Colusa ID, Provident, Princeton-Codora, Maxwell, and Colusa Basin Drain MWC.
3b	Tehama Colusa Canal Service Area. CVP Users: Orland-Artois WD, most of County of Colusa, Davis, Dunnigan, Glide, Kanawha, La Grande, Westside WD.
4	CVP Users: Princeton-Codora-Glenn, Colusa Irrigation Co., Meridian Farm WC, Pelger Mutual WC, Recl. Dist. 1004, Recl. Dist. 108, Roberts Ditch, Sartain M.D., Sutter MWC, Swinford Tract IC, Tisdale Irrigation, Sac River miscellaneous users.
5	Most Feather River Region riparian and appropriative users.
7	Sacramento Co. north of American River. CVP Users: Natomas Central MWC, Sac River miscellaneous users, Pleasant Grove-Verona, San Juan Suburban.
6	Yolo, Solano Counties. CVP Users: Conaway Ranch, Sac River Miscellaneous users.
9	Delta Regions. CVP Users: Banta Carbona, West Side, Plainview.
8	Sacramento Co. south of American River, San Joaquin Co.
10	Delta Mendota Canal. CVP Users: Panoche, Pacheco, Del Puerto, Hospital, Sunflower, West Stanislaus, Mustang, Orestimba, Patterson, Foothill, San Luis WD, Broadview, Eagle Field, Mercy Springs, Pool Exchange Contractors, Schedule II water rights, more.
11	Stanislaus River water rights: Modesto ID, Oakdale ID, South San Joaquin ID.
12	Turlock ID.
13	Merced ID. CVP Users: Madera, Chowchilla, Gravely Ford.
14	CVP Users: Westlands WD.
15	Tulare Lake Bed. CVP Users: Fresno Slough, James, Tranquillity, Traction Ranch, Laguna, Real. Dist. 1606.
16	Eastern Fresno Co. CVP Users: Friant-Kern Canal. Fresno ID, Garfield, International.
17	CVP Users: Friant-Kern Canal. Hills Valley, Tri-Valley Orange Cove.
18	CVP Users: Friant-Kern Canal, County of Fresno, Lower Tule River ID, Pixley ID, portion of Rag Gulch, Ducor, County of Tulare, most of Delano Earlimart, Exeter, Ivanhoe, Lewis Cr., Lindmore, Lindsay-Strathmore, Porterville, Sausalito, Stone Corral, Tea Pot Dome, Terra Bella, Tulare.
19	Kern Co. SWP Service Area.
20	CVP Users: Friant-Kern Canal. Shafter-Wasco, S. San Joaquin.
21	CVP Users: Cross Valley Canal, Friant-Kern Canal. Arvin Edison.

Table 15: Crops in CVPM

CVPM CROP GROUPINGS

Category	Proxy Crop (1)	Other Crops (2)	Unit of Measure
Wheat	Wheat		Tons
Miscellaneous grain	Barley	Oats, sorghum	Tons
Rice	Rice		Tons
Cotton	Upland cotton	Pima cotton	480-lb bales
Sugar beets	Sugarbeets		Tons
Corn	Field corn	Miscellaneous field crops	Tons
Miscellaneous hay	Grain hay	Sudan grass, other silage	Tons
Dry beans	Dry beans	Lima beans	Tons
Oil seed	Safflower	Sunflower	Tons
Alfalfa seed	Alfalfa seed	Wild rice, miscellaneous seed crops	Tons
Alfalfa	Alfalfa hay		Tons
Pasture	Irrigated pasture		Animal Unit Months
Processing tomatoes	Processing tomatoes		Tons
Fresh tomatoes	Fresh tomatoes		Tons
Melons	Canteloupe	Honeydew, watermelon	Tons
Onions	Dry onions	Dry and fresh onions, garlic	Tons
Potatoes	White potatoes		Tons
Miscellaneous vegetables	Peppers	Carrots, cauliflower, lettuce, peas, spinach, broccoli, asparagus, sweet potatoes, other truck vegetables	Tons
Almonds	Almonds	Pistachios	Tons
Walnuts	English walnuts		Tons
Prunes	Prunes	Plums and apricots	Tons
Peaches	Peaches	Nectarines, pears, cherries, apples, miscellaneous deciduous fruit	Tons
Citrus	Oranges	Lemons, grapefruit, miscellaneous subtropical fruit	Tons
Olives	Olives	Figs, kiwis, avocados, pomegranates	Tons
Raisin grapes	Raisins	Table grapes	Tons
Wine grapes	Wine grapes		Tons

NOTES:
(1) Production costs, yields, and prices for this crop used in the CVPM.
(2) Acreage data for these crops summed with the proxy crop.

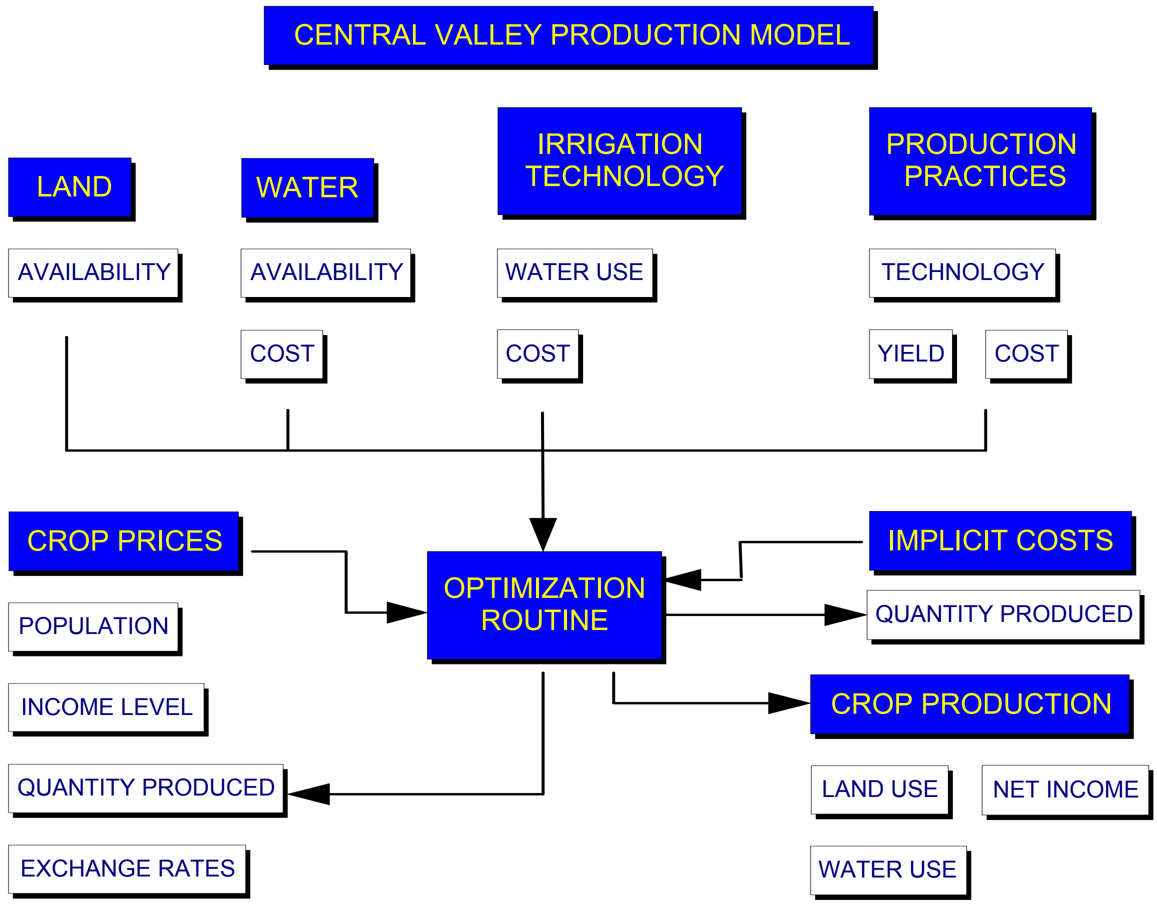

Figure 5: CVPM Input Data and Logic

Shown in Figure 5 are the data used by CVPM and the model logic flows. The model uses data on land availability, water availability and cost, the cost of increasing irrigation efficiency, and the costs and yields associated with crop production for individual crops. It also uses historical information on crop production to dynamically generate "implicit" crop production costs (real-world costs not captured in the above production cost data) based on the level of crop production. This reflects the fact that when the level of production of a crop increases, the additional production is generally done under less favorable circumstances (i.e., the "easiest to do" is assumed to be done first.)

The model also dynamically generates crop prices based on the level of crop production, reflecting the fact that, for many California crops, market prices respond significantly to the amount of the crop marketed. The crop prices generated are based on the level of consumer income, population, and competitiveness in foreign markets (exchange rates.)

For the purposes of the present study, the model was used to estimate the effect on the economic value of farm production from the change in SWP/CVP water deliveries from the base case to the with project case.

The analysis was done for three water year types: wet, average, and dry. The net economic benefits of the project were developed as an average annual value by weighting by year type frequency the product of the value of the delivery and change in deliveries for each year type.

The delivery values used were based on a CVPM run done for 2020 baseline (e.g., no action) conditions for a CALFED Water Management Strategy study. Table 16 shows the results of this run in terms of the economic benefit of an additional acre-foot of supply provided by the project at the farm headgate.

Agricultural groundwater pumping under the baseline study was examined using the CVGSM groundwater model and a determination was made that pumping depth impacts observed for the study would not significantly affect the value of agricultural surface water deliveries.

The benefits of an additional supply made available at the Delta, assuming no investment in additional conveyance capacity is required, can be determined by allocating that supply to the regions and subtracting the variable cost of delivery to the farm headgate. This variable cost was estimated to range from about $8 to $36 (in 1997 dollars) depending upon the region.

Because these values were based on a DWRSIM run with assumptions specific to CALFED requirements, the CALSIM run made for the present in-Delta storage study may have generated a higher level of deliveries for the base conditions. In, addition, the unallocated M&I deliveries reallocated to agricultural users increases the base level of deliveries from CALSIM by about five percent. For these reasons, the use of the values shown in Table 16 may somewhat overstate the benefits of the supplies generated by in-Delta storage. However, to the extent that these values represent avoided local groundwater pumping costs, the CVPM results may be relatively insensitive to such a discrepancy.

Both short-run and long run responses to changes in water resource conditions were evaluated. The purpose of the long-run analysis is to estimate average economic conditions after farmers have made permanent adjustments in response to changes in water availability and economic conditions.

Table 16: Computed Value of an Additional Acre-Foot of Supply at the Farm Headgate by CVPM Region and Water Year Type
(1997 Dollars)

	YEAR TYPE		
CVPM Region	WET	AVE	DRY
REG1	$38	$39	$41
REG2	$42	$42	$54
REG3	$37	$39	$50
REG3B	$37	$42	$53
REG4	$30	$32	$34
REG5	$30	$33	$34
REG6	$53	$55	$60
REG7	$40	$41	$46
REG8	$44	$44	$47
REG9	$33	$33	$36
REG10	$89	$89	$92
REG11	$31	$32	$35
REG12	$43	$38	$52
REG13	$43	$43	$60
REG14	$102	$105	$125
REG15	$67	$67	$82
REG16	$37	$39	$63
REG17	$44	$46	$74
REG18	$69	$72	$117
REG19	$102	$103	$106
REG20	$88	$90	$114
REG21	$89	$90	$111

The purpose of the short-run analysis is to estimate acreage, crop mix, and water use during both wet and dry years, given farmers' best possible responses to above or below normal water year situations. Permanent crop planting decisions are assumed to be made in response to long-run conditions and are therefore not subject to short-run conditions in the model.

When surface water availability is reduced, during dry years or due to long-term reductions, for example, the model simulates choosing among the following alternatives based on minimizing the impact on the economic value of farm production:

- Increased groundwater pumping
- Shifts to crops with lower water use
- Increased irrigation efficiency
- Reduced acreage planted

Shifting out of permanent crops and increased irrigation efficiency are responses assumed to be available only in the long-run.

The availability of interruptible water is generally announced too late (typically February, but it is not unusual for an announcement to be made as early as January or as late as March) for some seasonal planting decisions because of land preparation requirements, plantings of corn, dry beans, and tomatoes are made late enough to be able to take some advantage of the availability of this supply. In many instances, the interruptible supply is used for direct or in-lieu groundwater recharge.

This type of activity is best represented by the values to supply assigned by the model in wet years. Therefore, irrespective of the year type during which the interruptible water was available, the wet year values were assumed.

In the base case, unallocated contract SWP urban deliveries are allocated to SWP and CVP agricultural contractors in proportion to their deliveries under their respective contracts. The additional unallocated contract SWP urban deliveries produced by the project are used to augment CVP agricultural contract deliveries.

b. Agricultural Water Transfer Benefits

Also benefiting agriculture is the sale of water to urban users through market transfers. Because the payments by urban users for the transferred water include transactions costs for which they are assumed to be responsible as well as payments to farmers, the transfers were valued at the shadow value of the water for agricultural production in the San Joaquin Valley for the purpose of determining economic benefits to the agricultural sector. (This assumption does not preclude such transfer arrangements from making farmers' substantially better off financially, however.)

c. Summary of Agricultural Benefits

The agricultural water supply deliveries are shown in Table 17:

Table 17: Summary of Agricultural Water Supply Deliveries

Benefit Category	Scenario 2 (Study 2)		Scenario 3 (Study 3)		Scenario 4 (Study 4)	
	Annual Water Supply Improvement (TAF)		Annual Water Supply Improvement (TAF)		Annual Water Supply Improvement (TAF)	
	Dry Period	Long-term Average	Dry Period	Long-term Average	Dry Period	Long-term Average
Contract Supply						
SWP	13.3	19.3	12.6	18.7	8.2	12.5
CVP	6.9	52.6	5.4	31.5	5.4	33.2
Total	20.2	71.9	18.0	50.2	13.6	45.7
SWP A21 Supply	-1.7	-0.6	-1.6	-0.6	-0.7	1.1
SJV Sales (Transfers) to SF Bay Region	0.1	0.0	0.1	0.0	0.1	0.0
SJV Sales (Transfers) to South Coast Region	0.0	0.0	0.0	0.0	0.0	0.0
Total	18.6	71.3	16.5	49.6	13.0	46.8

Shown in Table 18 is a summary of the agricultural economic benefits described above.

Table 18: Summary of Agricultural Benefits
(2003 Dollars)

Benefit Category	($1,000)		
	Scenario 2 (Study 2)	Scenario 3 (Study 3)	Scenario 4 (Study 4)
SWP & CVP Supply[1]	$4,100	$2,958	$2,655
Value Received From Water Market	$2	$2	$3
Total	$4,102	$2,960	$2,658

[1]Includes urban supplies reallocated from South Coast Region urban use to San Joaquin Valley agricultural use and water market transfers from San Joaquin Valley agricultural use to the SF Bay and South Coast Region urban use

2.3.3 Unallocated Water Supply Deliveries

The addition of Kern Water Bank, Environmental Water Account, and Ecosystem Restoration Program, and/or CVPIA Level 4 Refuge demands allow total project deliveries to increase, but cause some reduction in urban and agricultural water deliveries. Many other operational scenarios are possible. For example each scenario includes a CVPIA Level 4 Refuge demand for modeling purposes, but could be replaced by other statewide water demands.

2.3.3.1 CVPIA Level 4 Refuge Supply

In-Delta Storage could provide water for supplies in addition to Level 2 refuge supply to meet Level 4 refuge supply and thus releases could be made to benefit CVPIA. It would protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley with additional water supply for refuges. This CVPIA use could also be considered as system-wide use and could assist in improving the operational flexibility of the CVP and achieving a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agriculture, municipal and industrial, and power contractors.

For this study, CVPIA refuge water supply will be considered as a benefit to the CVP. The supply is thereby valued as an avoided cost to CVP agricultural users of the refuge diversions no longer required, about $60 per acre foot.

2.3.3.2 Environmental Water Account (EWA)

This would be considered as make up water for any export reductions when SWP and CVP pumping is curtailed for specific actions in the Delta during the year. Storage space and associated EWA assets in the In-Delta Storage Project would enhance the ability of the EWA to respond to real-time fisheries needs and would eliminate the need to purchase a substantial portion of water needed by EWA each year. South of the Delta, where the water is more valuable to the program, the value based on recent experience is about $210 per acre-foot.

2.3.3.3 Ecosystem Restoration Program (ERP) Delta Flows

Releases from In-Delta Storage could help meet spring pulse flows proposed in the ERP. Project operations could also provide additional water quality and aquatic habitat improvements by releasing carryover water saved in islands storage. This water could be released at strategic times during fall and winter for environmental benefit. The avoided cost of water purchases for this purpose is estimated to be about $180 per acre foot.

2.3.3.4 Groundwater Recharge

Deliveries to the groundwater recharge areas in Kern County can be used to help mitigate groundwater management problems in the San Joaquin Valley. These deliveries are valued at the average alternative cost of agricultural groundwater pumping in the San Joaquin Valley, about $55 per acre foot.

2.3.3.5 Summary of Benefits of Unallocated Supply Deliveries

The unallocated supply deliveries are shown in Table 19:

Table 19: Summary of Unallocated Water Supply Deliveries

Benefit Category	Scenario 2 (Study 2)		Scenario 3 (Study 3)		Scenario 4 (Study 4)	
	Annual Water Supply Improvement		Annual Water Supply Improvement		Annual Water Supply Improvement	
	Dry Period	Long-term Average	Dry Period	Long-term Average	Dry Period	Long-term Average
Groundwater Recharge	4.5	21.1	1.4	10.1	1.4	12.3
Envioronmental Water Account			10.3	31.2	9.7	36.7
Ecosystem Restoration Program					14.9	15.7
CVPIA Level 4 Refuges	5.5	14.6	3.4	11.0	3.4	11.7
Total	10.0	35.7	15.1	52.3	29.4	76.4

The economic benefits assigned to the unallocated supply deliveries are shown in Table 20:

Table 20: Summary of Unallocated Supply Delivery Economic Benefits
(2003 Dollars)

Benefit Category	($1,000)		
	Scenario 2 (Study 2)	Scenario 3 (Study 3)	Scenario 4 (Study 4)
Groundwater Recharge	$991	$534	$648
Environmental Water Account	$0	$6,552	$7,707
Ecosystem Restoration Program	$0	$0	$2,826
CVPIA Level 4 Refuges	$876	$693	$702
Total	$1,867	$7,779	$11,883

2.3.4 Recreation

The proposed recreation plan will increase the number of hunting, fishing, hiking, biking, and interpretative experiences currently available. In addition, all the facilities would be public rather than private.

2.3.4.1 Existing Recreation Days

Table 21 shows the estimated number of recreation use days that currently exist on the four islands. Hunting is private except for for-fee use on Holland Tract. Except for Holland Tract, fishing on the other islands occurs on the levees and is private. Two marinas exist on Holland Tract and account for the high numbers of boaters using the island.

Table 21: Estimated Recreation Use Days on All Four Islands as Of 1995

Island	Hunting (Use Days)	Fishing/Boating (Use Days)
Bacon Island	100	3120
Webb Tract	640	90
Bouldin Island	210	360
Holland Tract	60	57,050
Total	1,010	60,620
source: JSA 1995		

2.3.4.2 Expected Recreation with In-Delta Storage Project

Table 22 shows the estimated number of recreation use days that could be expected with the In-Delta Storage Project.

Table 22: Estimated Recreation Use Days on All Four Islands Under The In-Delta Storage Project

	Hunting (Use Days)	Fishing/Boating (Use Days)	Other (Use Days)
All Islands	9,019	195,840	33,000

It is likely that the proposed hunting will create significant new hunting opportunities for the public. The fishing, boating, hiking, biking, wildlife observation and use of the interpretative center will only generate 10-20 percent new users.

The proposed hunting will create significant new hunting opportunities for the public. The fishing, boating, hiking, biking, wildlife observation and use of the interpretative center will only generate 10-20 percent new users, however.

It was assumed for this study that the all of the hunting days induced by the public hunting opportunity provided by the proposed project will be new days with the exception of the existing hunting on the affected islands. “New” days are those which are not defined by visits which would have been made elsewhere in California for the same purpose anyway or just represent an enhanced experience in the same location. These days are assumed to be over and above the existing days as estimated by JSA (1995), representing a net gain after accounting for lost recreation associated with conversion of Bacon and Webb to reservoir islands.

In contrast, it was assumed that only twenty percent of the days generated by fishing, hiking and biking, and wildlife interpretation will be new days and only ten percent of the boating days were assumed to be new.

Table 23: Estimated Recreation Benefits
(2003 Dollars)

Category	Visitor Days	New User Factor	New Users	Unit Day Benefit	Total Benefit
				$/Day[1]	($1,000)
Hunting	9,019	100%	9,019	$24.18	$218
Fishing	9,600	20%	1,920	$16.93	$33
Hiking/Biking	3,000	20%	600	$16.93	$10
Intrepretation	30,000	20%	6,000	$16.93	$102
Boating	186,240	10%	18,624	$16.93	$315
Total	237,859		36,163		$678

[1]US Army Corps of Engineers Economic Guidance Memorandum 01_01, Unit Day Values for Recreation, Fiscal Year 2001 (indexed for inflation)

Shown in Table 23 are the results of the benefit calculations. Visitor days were obtained from the November 2001 Recreational Options Technical Memorandum prepared by CH2M HILL. Unit day benefit values were obtained from the US Army Corps of Engineers Economic Guidance Memorandum 01_01, Unit Day Values for Recreation, Fiscal Year 2001.

2.3.5 Flooding Risk Benefits

The benefits of reducing the probability of incurring the economic costs of levee breach events on Webb Tract and Bacon Island under conditions with and without the proposed project were evaluated by the URS Corporation, “In-Delta Storage Program Risk Analysis”, May 2003. Table 24 shows the results of the study. The significant costs evaluated included:

- Breach Repair
- Fish Entrainment Recovery
- Fish Mitigation
- Loss of Water Supply
- Marina Repair

Table 24: Economic Benefits of Flooding Risk Reduction
(2003 Dollars)

Reservoir Island	Expected Dollar Risk ($1000)		
	Without Project	With Project	Risk Reduction
Webb Tract	$263	$42	$221
Bacon Island	$145	$42	$102
Both	$408	$84	$324

In the absence of the in-Delta Program, relatively frequent failures can continue to be expected if the islands are maintained for agricultural production. Losses associated with crop and farm equipment damage from flooding depends upon the time during the year when the flooding occurs. If the crop has been harvested and the farm equipment moved out of the fields to high ground, the consequences can be relatively minor. If, however, the farmer had invested in crop cultivation for a full growing season and the flood occurred just prior to harvest, the damage would be substantial, particularly if there was insufficient time to move vulnerable equipment.

After a future flood event, the willingness and ability to pay to restore an affected island to agricultural production may not be present, however. One, albeit probably unlikely, alternative might be to maintain it in a flooded state with the breach repaired and the interior of the levee rocked in order to preserve the Delta channels. Another, more likely, alternative might be for the State to take responsibility for levee restoration and maintenance in order to operate the island for wildlife habitat.

The development of suitable scenarios for fully evaluating the likely flood damage reduction benefits for the purpose of this study has not been done at this time.

2.3.6 Avoided Levee Maintenance Costs

The In-Delta storage project will replace the current levee maintenance program on the affected islands. The cost of the new program is included in the project costs, given above. The estimated avoided costs of the current program are shown in Table 25. These costs are based upon the average maintenance expenditures for the period 1990 to 2001.

Table 25: Expected Avoided Annual Levee Maintenance Expenditures
(Thousands of 2003 Dollars)

Island				
Bacon	Bouldin	Holland	Webb	All
$180	$217	$96	$218	$711

2.3.7 Summary of Quantified Benefits

Provided in Table 26 is a summary of the benefit analyses described above.

Table 26: Economic Benefits Summary
(2003 Dollars)

Benefit Category	($1,000) Scenario 2 (Study 2)	Scenario 3 (Study 3)	Scenario 4 (Study 4)
Urban	$16,741	$15,598	$10,305
Agricultural	$4,102	$2,960	$2,658
Unallocated	$1,867	$7,779	$11,883
Subtotal Supply Benefits	$22,710	$26,337	$24,846
Recreation	$678	$678	$678
Flooding Risk Reduction	$324	$324	$324
Avoided Levee Maintenance	$711	$711	$711
Total	$24,423	$28,050	$26,559

2.3.8 Benefits Requiring Further Analysis to Quantify
2.3.8.1 Delta Benefits

a. Contribution to Water Quality Management Plan (D 1641) Delta Requirements

- Although there are no additional D1641 requirements imposed on In-Delta Storage operations, coordination with the SWP/CVP is required under the CUWA/DW agreement. With this coordination both the SWP and CVP would benefit, because the In-Delta Storage Project could make water available for D1641 more quickly and efficiently than releases from upstream reservoirs.

b. Aquatic Resources

- Fish species will benefit in a variety of ways. State of the art fish screens are included in the In-Delta Storage proposal. Storing water in the Delta near the State and federal water project pumping facilities improves the ability of the projects to time pumping to avoid affecting at-risk fish species. By storing surplus flows in the Delta, diversions from the Trinity and American River basins can be reduced and carryover storage in upstream reservoirs increased, allowing improved flows for fisheries on both rivers. Additional ecosystem benefits will accrue from improved environmental water quality. Frequent circulation or exchange of water within the island reservoirs may release algae and zooplankton, a food source for fish.

2.3.8.2 Carryover Storage

The carryover storage is available for use by the projects for south of the Delta supplies and water quality improvements or environmental instream uses on the Sacramento and Feather rivers. Folsom carryover can be used for flow improvements in the American River. Any carryover storage in upstream SWP and CVP reservoirs could be transferred to In-Delta storage on interim basis during times when Banks and Tracy Pumping Plants do not have a pumping capacity to transfer water to the South.

2.3.8.3 Wildlife Habitat Improvements

Wildlife habitats will be improved and protected by developing terrestrial, aquatic and wildlife-friendly agricultural habitats on Holland Tract and Bouldin Island.

2.3.8.4 Interim Banking for Water Transfers Storage

North to South negotiated water transfers between SWP and CVP users could also make use of the In-Delta storage for interim parking. As negotiated amounts of transfer depend on many factors including carryover storage, available supplies and storage space, this would require future detailed work for estimation in terms of monetary value.
Recent instances of south of the Delta users having completed negotiations on purchase but could not find interim storage identifies need for storage space like being provided by the In-Delta Storage Project.

2.3.8.5 Seismic Stability Benefits

The current designs do not provide for assured non-failure of the proposed storage facilities during strong seismic loading. Instead, the risk of failures (or breaches) of the proposed reservoirs are considered in the current planning and design as an acceptable level of risk. Such breaches would be significantly less costly to repair than typical failures of "existing" Delta levees, as embankment widths are greater and differential water elevations between the reservoirs and adjacent sloughs are greatly reduced during periods of reservoir storage. Also important is the reduction of the consequences of potential failures during low flow periods in the sloughs (summer and fall). During these periods, the reservoirs would be full or at least partially full, so that potential failures would not result in drawing water into the failed islands, resulting in increased salinity levels. Instead, fresh water would be released, with beneficial impact on salinity levels into what would be a damaged overall Delta system, and minimization of scour damage would facilitate rapid repair of potential failures on the two project islands.

These are potentially very significant project benefits, but their value is difficult to assess, and depends to some extent on the actions that may be taken to reduce seismic vulnerability of appurtenant islands, levees, and other Delta facilities.

2.3.8.6 Water Quality Improvements

a. Drinking Water Quality

- Storage in the Delta would provide additional water to meet drinking water requirements under Water Quality Control Plan (SWRCB D1641) obligations and any future restrictions. In-Delta Storage will be used to push salinity downstream during summer and fall months to improve water quality conditions in Delta channels and at the urban export pumps. Better water quality at the export pumps will result in drinking water treatment costs savings.

b. Environmental Water Quality

- Storage in the Delta would provide additional water to meet environmental water quality and flow requirements under SWRCB D1641 obligations and any future restrictions. Water saved in upstream reservoirs by using In Delta storage water to meet D1614 requirements is available for other uses including water quality and ecosystem purposes.

2.3.8.7 Value of Operational Flexibility

In-Delta storage will increase operational flexibility of SWP and CVP systems due to availability of stored surplus flows, capability of the In-Delta Storage Project to provide water at different times and its strategic location to respond to emergencies in the Delta. Multipurpose type operations are possible as demonstrated in Draft Report on Operations.

Chapter 3: ECONOMIC IMPACT ANALYSIS

3.1 General

The economic impact analysis was designed to identify potential gains and losses to the area local to the proposed project stemming from changes in the economy of the area due to the existence of the project. This analysis was made to disclose the potential for both positive and negative impacts to the local economy. While a economic benefit cost analysis done for economic justification purposes is traditionally done from a larger perspective (e.g., a regional or Statewide perspective) and incorporates only direct costs and benefits, an economic impact analysis considers indirect and induced local economic effects—the "ripple" effects.

For this purpose, Input-Output models designed to identify economic linkages in the local economy were employed. These linkages exist because a change in the level of any economic activity in one sector of the economy affects the level of activity of those sectors of the economy which provide it with goods and services. Farmers, for example, depend on the output of tractor manufacturers and dealers and, depending upon the crop, custom services for harvesting. Those providing custom services for harvesting, in turn, depend upon the output of harvest equipment manufacturers, equipment repair services, and fuel suppliers and so on.

I-O models, as most models, are best for evaluating relative impacts. I-O models represent a snapshot of the economy at a fixed point in time. In this case, it represents a snapshot of the economy in San Joaquin and Contra Costa Counties. I-O analysis handles changes using fixed factors, no flexibility to adapt is assumed, with each resource unit is assumed to be as productive as any other. No allowance is made for local businesses and individuals to respond to market signals to "make the best of" the remaining opportunities in the local area or outside of the local area.

The effects generated by the Input-Output models are classified as direct (e.g., cut in farm production), indirect (e.g., reduced need for custom harvesting services), and induced. The induced effects arise from the change in income due to the direct and indirect effects. This income change affects the overall level of consumption of goods and services.

For the purposes of the impact analysis, the linkages are evaluated only in so far as they affect local economic activity. The impact on equipment manufacturers in other parts of California or other states is not included, for example. Also outside of the scope of this impact analysis are the same types of economic effects which occur in the areas benefiting from the additional water supply reliability provided by the proposed project.

Changes in local economic activity evaluated in this section arise from:

- Loss of expenditures for crop production.
- Loss of expenditures on existing levee maintenance regime.

- Expenditures on operations and maintenance of the proposed project facilities (including recreation facilities).
- Expenditures related to additional recreation days produced by the proposed project.

The impact numbers generated for these evaluations represent the sum of the direct, indirect, and induced economic effects and were developed using a MIG IMPLAN model set up for Contra Costa and San Joaquin counties. The income effects shown are for employee compensation and proprietor's income effects, those effects directly linked to employment. Effects on employee compensation and proprietor's income represent approximately two-thirds of total household income effects, the other third being effects on income from rental property and capital investments.

3.1.1 Loss of Crop Production

Table 27 shows the change in agricultural crop acres due to the proposed project. The calculation of the net change includes accounting for the Habitat Management Program that is assumed to be implemented under the with project conditions.

Table 27: Estimated Net Change in Crop Acres Due To Proposed Project

Crops	Existing Acres					HMP Acres					Net Change				
	Webb	Holland	Bouldin	Bacon	Total	Webb	Holland	Bouldin	Bacon	Total	Webb	Holland	Bouldin	Bacon	Total
Harvested															
Alfalfa							935	1,925		2,860		935	1,925		2,860
Corn (field)	3,250		3,200	2,200	8,650						-3,250		-3,200	-2,200	-8,650
Safflower				800	800		170			170		170		-800	-630
Small grains	900		1,600	500	3,000						-900		-1,600	-500	-3,000
Sunflowers				1,200	1,200									-1,200	-1,200
Tomatoes (Fresh)			150		150								-150		-150
Pasture		2,500			2,500							-2,500			-2,500
Unharvested															
Corn							106	339		445		106	339		445
Small Grains							595	1,225		1,820		595	1,225		1,820
Total	4,150	2,500	4,950	4,700	16,300		1,806	3,489		5,295	-4,150	-694	-1,461	-4,700	-11,005

Table 28 shows the yield and price assumptions used for the IMPLAN impact analysis.

Table 28: Crop Price and Yield Assumptions
(1997 Dollars)

Crops	Yield				Price per Unit			
	Webb	Holland	Bouldin	Bacon	Webb	Holland	Bouldin	Bacon
Alfalfa		7.0	7.0			$124	$128	
Corn (field)	4.7		5.1	5.1	$100		$123	$123
Safflower		1.1		1.5		$338		$329
Small grains	1.7		2.9	2.9	$126		$128	$128
Sunflowers				1.2				$387
Tomatoes (Fresh)			15.0				$413	
Pasture		1.0				$92		

Table 29 shows the estimated local employment and employee and proprietor income and employment impacts of the loss of that production on each of the affected Delta islands as a consequence of the proposed project.

Table 29: Local Employment and Employee and Proprietor Income and Employment Effects from Change in Agricultural Production
(2003 Dollars)

Crops	Income ($1,000)					Jobs				
	Webb	Holland	Bouldin	Bacon	Total	Webb	Holland	Bouldin	Bacon	Total
Harvested										
Alfalfa		$1,357	$2,862		$4,219		68.9	145.3		214
Corn (field)	-$1,378		-$1,787	-$1,228	-$4,393	-56.9		-73.5	-50.5	-181
Safflower		$56		-$369	-$313		2.4		-15.5	-13
Small grains	-$205		-$625	-$195	-$1,025	-9.4		-28.7	-9.0	-47
Sunflowers				-$514	-$514				-21.6	-22
Tomatoes (Fresh)			-$832		-$832			-25.3		-25
Pasture		-$320			-$320		-16.6			-17
Unharvested										
Corn		$33	$147		$179		1.3	5.9		7
Small Grains		$97	$373		$470		4.5	17.3		22
Total	-$1,583	$1,223	$138	-$2,307	-$2,529	-66	61	41	-97	-61

The crop income effects shown are the result of indexing 1997 crop prices. Based on a weighted average, prices received in 1997 resulted in about a 20 percent higher income compared to the income from average prices received for the period 1997 to 2001. To the extent the 1997 may be an unusually high income year for the purposes of forecasting future impacts, income and the economic impacts arising from that income may be overstated.

The lower average income would be unlikely to result in lower expenditures on farm operations, however. The crops would still need basically the same inputs to be produced and harvested. More likely, farm operators and land owners would have less income over expenses compared to the 1997 situation.

Helping to offset this lower of income to farm operators and land owners from market sales is the income from government crop support payments. When crop market receipts are lower, the income from government payments has historically been higher. Crops which would be affected by the in-Delta project which are presently eligible for federal farm program payments include wheat, corn, safflower, and sunflower seeds. Forecasting the nature, size, or even the existence of future federal farm programs, the programs' impact on crop market prices and the participation by growers on the affected islands is problematical.

Taken into account in Table 29 is the fact that the grain and hay and corn crops which would remain on Bouldin and Holland would no longer be harvested under the proposed habitat management program. The expenditures on harvesting will no longer be incurred and thus contribute to income and employment impacts in the local area.

Not taken into account in Table 29 is the full effect of the loss of crop production on those activities related to the storage and processing of the crops produced after they leave the farm. To the extent that these activities take place in the local area, or to extent that local storage facilities and processors cannot substitute other crops, this represents a loss not captured in this evaluation. How much of this impact would fall on the local area is difficult to estimate, however. The impact of the loss of hauling is included, however, and is assumed to be a local impact.

This analysis was based on crop surveys done by the Department in 1995 and 1996, information on more recent cropping provided by Delta Wetlands staff, and the proposed Habitat Management Plans for Bouldin Island and Holland Tract. Price and yield data from the County Agricultural Commissioner's Reports were also used.

3.1.2 Gains from Operations and Maintenance of the Project Facilities

Operation and maintenance expenditures for the water supply and recreation facilities will have a positive effect on local employment and income. Table 30 shows the indirect, and induced economic gains for the project. The recreation plans recommended by CH2M HILL for Alternatives 1, 2 & 3 are assumed to be implemented. Table 31 reflects the fact that employment and income current levee maintenance activity will be forgone, however, when that activity is superceded by the proposed project.

Table 30: Local Employment and Employee and Proprietor Income Effects from Operation and Maintenance Expenditures
(2003 Dollars)

Expenditure Category	Expenditures ($1,000)	Generated	
		Employment (FTE)	Income ($1,000)
Maintenance	$4,307	113	$4,604
Energy	$956	3	$200
Operating Staff Compensation	$610	13	$944
Total	$5,873	128	$5,747

Table 31: Local Employment and Employee and Proprietor Income Effects from the Discontinuation of Current Levee Maintenance Expenditures
(2003 Dollars)

Expenditure Category	Expenditures ($1,000)	Generated	
		Employment (FTE)	Income ($1,000)
Maintenance	$711	19	$760

3.1.3 Recreation Gains

The additional days of recreation generated by the proposed project will also have a positive effect on local employment and income. This arises from expenditures by recreationists in the local area. Table 32 shows the indirect, and induced economic recreational gains for each alternative. The increase in recreation will likely generate about 35 FTE jobs and contribute about $900,000 in employee and proprietor income to the local economy.

It was assumed for this study that the all of the hunting days induced by the public hunting opportunity provided by the proposed project will be new days with the exception of the existing hunting on the affected islands (see above.) “New” days are those which are not defined by visits which would have been made elsewhere in the local area or just represent an enhanced experience for visitors who would be in the same location anyway. In both of these cases, additional local expenditures are not generated.

Table 32: Local Employment and Employee and Proprietor Income Effects of Recreation Expenditures
(2003 Dollars)

Activity Type	Visitor Days[1]	Expenditures[2]	New User Factor	Total Regional Expenditures Factor[3]	Total Regional Expenditures ($1000)	Generated Employment (Persons)	Generated Income ($1000)
Hunting	9,019	$41.05	89%	50%	$164	8	$205
Fishing	9,600	$43.28	20%	50%	$42	2	$52
Hiking/Biking	3,000	$41.05	20%	50%	$12	1	$15
Intrepretation	30,000	$41.05	20%	50%	$123	6	$153
Boat Visit Days	186,240	$41.05	10%	50%	$382	19	$476
Total	237,859				$724	35	$901

[1]Based on CH2MHill Recreational Options Technical Memo (Nov 30, 2001)
[2]Based on 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of the Interior
[3]Estimated from Sacramento-San Joaquin Delta Recreation Survey (1995)

In contrast, it was assumed that only twenty percent of the days generated by fishing, hiking and biking, and wildlife interpretation and only ten percent of the boating days will be new days. It was also assumed that trip expenditures within the Delta area and, therefore, affecting the local economy, were about one-half of the total trip expenditures. Not counted were expenditures outside the Delta but in nearby areas that would still be of significant benefit to the local economy.

Visitor days were obtained from the November 2001 Recreational Options Technical Memorandum prepared by CH2M HILL. California expenditure numbers were adopted from the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation report done by the U.S. Department of the Interior. The percentage of expenditures made within the Delta was developed from information in the 1995 Sacramento-San Joaquin Delta Recreation Survey done for the California Department.

3.2 Net Local Employment and Income Effects

Table 33 shows the net effect on the local economy of the loss of agricultural production on the affected islands, the additional recreation expected from the proposed project, and the operations and maintenance activities which will be required to operate the water supply facilities as well as the recreation facilities. The In-Delta Storage Project will have minimal adverse impact because agricultural losses are substantially offset by increased recreation and maintenance jobs and income.

Table 33: Net Local Employment and Employee and Proprietor Income Effects
(2003 Dollars)

Effect Category	Employment (FTE)	Income ($1,000)
Agricultural Production	-61	-$2,529
Current Levee Maintenance	-19	-$760
Recreation	35	$901
Operations and Maintenance	128	$5,747
Net Effect	83	$3,359

3.3 Net Local Sales Tax Revenue Effects

Shown in Table 34 are the estimated overall net positive fiscal effects on local public revenues from sales taxes. These values were estimated using the IMPLAN model to link the changes in local expenditures to local retail trade activity. One percent of the retail sales were assumed to be returned to the counties as sales tax revenues.

Table 34: Net Local Sales Tax Revenue Effects
(2003 Dollars)

Effect Category	Taxes ($1,000)
Agricultural Production	-$4
Current Levee Maintenance	-$2
Recreation	$7
Operations and Maintenance	$9
Net Effect	$11

APPENDIX A

Potential Benefits Sensitivity Analysis

This sensitivity analyses was performed to determine the impact of variations in various assumptions and procedures used in the urban economic models for assessing the potential benefits. The LCPSIM Model input is based partially on B160-98 assessment of the available regional management options or regional water use efficiency options (e.g., conservation, wastewater recycling, groundwater reclamation etc.) to meet shortages and partially on estimates developed during the CALFED Programmatic EIS/EIR process.

As shown in Table 11 in the main report, Study Scenario 2 for In-Delta Storage Project produces approximately $14 million of quantified average annual water supply benefits for the South Coast Region. As an example case, the results of the LCPSIM urban economic model application to the South Coast Region for Sample Scenario 2 were further analyzed in this sensitivity analysis. Based on the use of supplies from the regional management options, related shortage costs were assessed for different levels of the costs of and availability of those options. Figure A.1 shows variations in supply from the regional options, costs of supplying local water to meet shortages, the contribution of the In-Delta Storage Project and variations in the potential benefits. This figure was produced from the information shown in Tables A.2 through A.7, below.

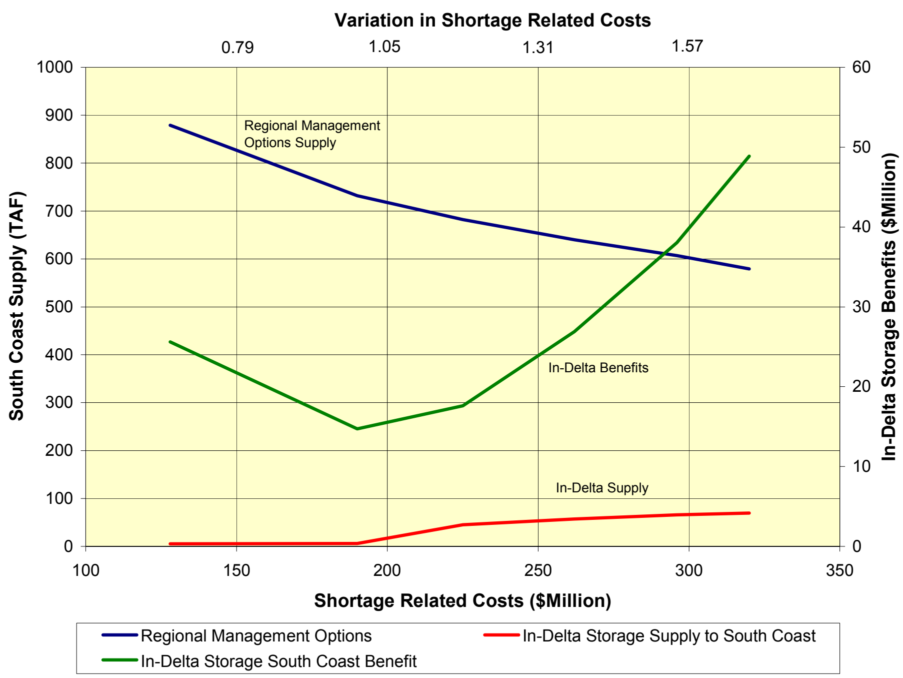

Figure A.1: Sensitivity Analysis for South Coast Management Options Assumptions

The sensitivity analysis indicate that there is a significant variation in South Coast benefits, and the results of the economic analyses are very sensitive to assumptions about the cost and availability of regional water use efficiency options. In general, if the assumptions are unreasonably optimistic about cost and/or availability of the regional options, the value of the In-Delta Storage Project will be understated.

Table A.1 was produced by changing the costs of the regional water use efficiency options available for the South Coast Region relative to the cost assumptions used for the results shown in Table 11 in the main report and in Table A.3, below.

Table A.1: Effect of Alternative Regional Option Cost Scenarios on Study Scenario 2 South Coast Region Urban Benefits

Study Scenario	Regional Water Use Efficiency Option Scenario					
	Option Costs 50% Lower	Base Options Costs	Option Costs 25% Higher	Option Costs 50% Higher	Option Costs 75% Higher	Option Costs 100% Higher
Scenario 2	$25,601	$14,723	$17,606	$26,903	$38,049	$48,848

Detailed information on the results of the model runs that were used to generate this information are shown in Tables A.2 though A.7.

Table A.2: South Coast Region Scenario 2 Study Results Regional Options Costs 50% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		77.6
Net Avg Incremental Delivered Urban Supply (TAF)		5.3
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		10.8
Average Incremental Urban Delivered Dry Period Supply (TAF)		24.9
Avoided Costs/Losses ($1,000)		$25,601
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$128,236	-$34,454
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	2,138	-456.0
Total Cost ($1,000)	$402,211	-$85,785
Annual Average Cost ($1,000)	$5,125	-$1,175
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	401	0
Groundwater Recovery (TAF)	93	0
Recycling (TAF)	385	13
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	879	13
Total Annual Option Cost ($1,000)	$238,180	$5,678
Expected Incremental Operations Costs ($1,000)	$6,435	$4,350
Total Expected Costs and Losses ($1,000)	$378,362	-$25,601

Table A.3: South Coast Region Scenario 2 Study Results Regional Options Costs 100% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		76.5
Net Avg Incremental Delivered Urban Supply (TAF)		6.4
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		10.8
Average Incremental Urban Delivered Dry Period Supply (TAF)		24.9
Avoided Costs/Losses ($1,000)		$14,723
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$190,234	-$25,854
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	2,900	-44.0
Total Cost ($1,000)	$545,563	-$8,278
Annual Average Cost ($1,000)	$6,952	-$113
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	300	13
Groundwater Recovery (TAF)	89	0
Recycling (TAF)	343	0
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	732	13
Total Annual Option Cost ($1,000)	$346,124	$10,470
Expected Incremental Operations Costs ($1,000)	$45,961	$775
Total Expected Costs and Losses ($1,000)	$589,792	-$14,723

Table A.4: South Coast Region Scenario 2 Study Results Regional Options Costs 125% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		37.9
Net Avg Incremental Delivered Urban Supply (TAF)		45.1
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		4.9
Average Incremental Urban Delivered Dry Period Supply (TAF)		30.7
Avoided Costs/Losses ($1,000)		$17,606
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$225,234	$9,148
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	3,056	-6.0
Total Cost ($1,000)	$574,910	-$1,129
Annual Average Cost ($1,000)	$7,326	-$15
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	269	-40
Groundwater Recovery (TAF)	81	0
Recycling (TAF)	332	0
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	682	-40
Total Annual Option Cost ($1,000)	$383,177	-$36,428
Expected Incremental Operations Costs ($1,000)	$57,667	$9,689
Total Expected Costs and Losses ($1,000)	$673,953	-$17,606

Table A.5: South Coast Region Scenario 2 Study Results Regional Options Costs 150% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		25.6
Net Avg Incremental Delivered Urban Supply (TAF)		57.4
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		3.4
Average Incremental Urban Delivered Dry Period Supply (TAF)		32.3
Avoided Costs/Losses ($1,000)		$26,903
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$261,889	$26,825
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	3,213	-40.0
Total Cost ($1,000)	$604,446	-$7,525
Annual Average Cost ($1,000)	$7,702	-$103
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	224	0
Groundwater Recovery (TAF)	82	-27
Recycling (TAF)	334	-37
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	640	-64
Total Annual Option Cost ($1,000)	$413,853	-$63,900
Expected Incremental Operations Costs ($1,000)	$63,301	$10,275
Total Expected Costs and Losses ($1,000)	$747,323	-$26,903

Table A.6: South Coast Region Scenario 2 Study Results Regional Options Costs 175% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		17.3
Net Avg Incremental Delivered Urban Supply (TAF)		65.7
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		3.4
Average Incremental Urban Delivered Dry Period Supply (TAF)		32.3
Avoided Costs/Losses ($1,000)		$38,049
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$296,220	$31,616
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	3,463	89.0
Total Cost ($1,000)	$651,477	$16,743
Annual Average Cost ($1,000)	$8,302	$229
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	224	0
Groundwater Recovery (TAF)	68	-31
Recycling (TAF)	315	-42
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	607	-73
Total Annual Option Cost ($1,000)	$443,032	-$79,272
Expected Incremental Operations Costs ($1,000)	$65,952	$9,378
Total Expected Costs and Losses ($1,000)	$814,128	-$38,049

Table A.7: South Coast Region Scenario 2 Study Results Regional Options Costs 200% of Base Options Costs

Regional Economic Benefits		Study Alternative
		urban_deliv_study2
Avg Incremental Available Urban Supply (TAF)		82.9
Avg Incremental Unallocated Urban Supply (TAF)		13.5
Net Avg Incremental Delivered Urban Supply (TAF)		69.5
Average Incremental Urban Dry Period Available Supply (TAF)		35.6
Average Incremental Urban Unallocated Dry Period Supply (TAF)		3.4
Average Incremental Urban Delivered Dry Period Supply (TAF)		32.3
Avoided Costs/Losses ($1,000)		$48,848
Regional Water Management -- Least-Cost Planning Criterion		
Expected Shortage-Related Costs/Losses ($1,000)	**Without Project**	**Change from Without Project (Costs/Losses are Annual Values)**
	$329,279	$32,005
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Total Quantity Transferred (TAF)	3,632	145.0
Total Cost ($1,000)	$683,270	$27,278
Annual Average Cost ($1,000)	$8,707	$374
Water Supply/Water Use Efficiency Option Use and System Operations		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	224	0
Groundwater Recovery (TAF)	56	-33
Recycling (TAF)	299	-44
Seawater Desalting (TAF)	0	0
Total Option Use (TAF)	579	-77
Total Annual Option Cost ($1,000)	$469,858	-$90,117
Expected Incremental Operations Costs ($1,000)	$66,955	$8,889
Total Expected Costs and Losses ($1,000)	$875,452	-$48,848

Another source of sensitivity is the assumption of how much value water users place on water system reliability by user class. In general, if these values are unreasonably low, the value of the In-Delta Storage Project will again be understated.

Other assumptions in the model which can affect the benefits of the In-Delta Storage Project include the costs of aqueduct conveyance, regional distribution and treatment, and put and take operations for groundwater carryover storage. These latter costs are very dependent on assumptions about future energy costs. Assumptions about costs and constraints related to shortage contingency water transfers are also important. Additionally, assumptions about regional carryover storage capacities for surface and groundwater as well as annual put and take capabilities for regional groundwater operations help determine the value of the In-Delta Storage Project. Additionally, assumptions about expected future regional water use and the availability of other imported and local regional supplies as well as regional capacities for surface and groundwater carryover storage (and annual put and take capabilities for regional groundwater operations) can affect the value of the In-Delta Storage Project.